PUBLIC WORKS
CITY COUNTY STATE
AN ENGINEERING AND CONSTRUCTION MONTHLY
Vol. 60 August, 1929 No. 8

Natural Snow Fences

Planting trees and shrubs to prevent snow drifts. Choice between the two, selection of site, and cost of planting and maintaining. Other considerations in roadside planting

By R. A. Drought*

The demand for the open road in the winter months of the year has come to stay. Good roads are a business proposition, and maximum utility is universally recognized as the primary function of roads and highways.

The problems of snow removal and of snow drift prevention therefore become paramount. It is more economical to prevent snow drifts than it is to remove drifted snow, for one adequate snow fence will prevent the drifts of an entire winter, and will save the time, money, and effort usually expended in clearing the highways after each snowstorm. The cost of snow removal is sometimes prohibitive for individual counties,† but with adequate means for preventing snow drifts, the expense may be considerably lessened. Furthermore, an advance guarantee of a clear road ahead is appreciated by the public.

Various types of snow fence are in use at the present time. The collapsible wooden fence with upright one-inch slats is most popular in many sections of Wisconsin, with the horizontal slat metal fence being used occasionally. But the possibilities of the natural snow fence—the snow fence of trees or of shrubs—has not been adequately considered nor given a fair trial; and yet it has many points to commend it, not least among them the item of cost. The objections to the natural snow fence are usually considered before its assets, and the natural snow fence idea is accordingly tossed aside as being impractical.

In addition to the purely utilitarian aspects of preventing snow drifts, the highway engineer, in providing a natural snow fence, has the opportunity of interpreting for the public the social significance of beauty, of providing in terms of native landscape some relief from the conditions imposed by city life that eventually become overpowering. For beauty is a potent force in bringing relaxation and calm of spirit in an age of hectic haste.

The chief problems involved in the use of natural snow fences are the selection of site for the snow fence, securing the necessary right of way, selection of plant materials, planting and maintenance.

*Department of Horticulture, University of Wisconsin.
†During the winter of 1929, several of the countries in Wisconsin found it necessary to petition the state legislature for state aid in removing snow from the highways.

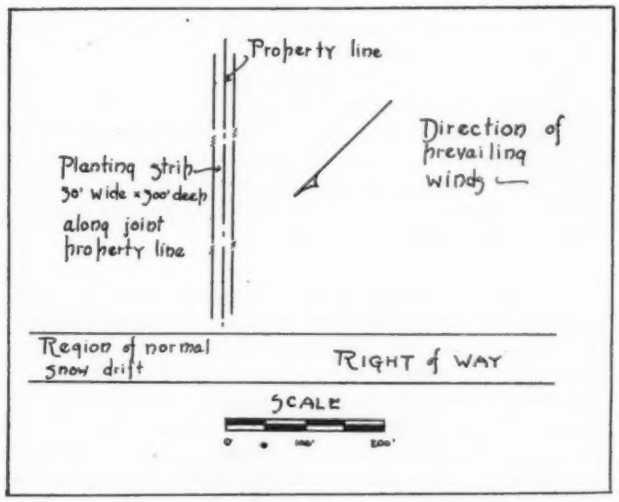
SELECTION OF SITE

While it is impossible to predict with mathematical accuracy the exact location and extent of a snow drift, it is possible to study prevailing winds and eddy currents, with relation to road cuts and previously observed drifts, and to locate a snow fence accordingly. The possibility of incorrectly forecasting the location of a snow drift is no greater when a natural snow fence is considered than when an artificial snow fence is under construction.

It is not always essential to secure land parallel tc the highway for a snow fence. Twenty or thirty feet of land may be secured along joint property lines at right angles to the highway for a distance of 300 to 500 feet back from it, and planting may be done along this strip. This, of course, presupposes that the terrain and prevailing winds warrant such a procedure.

SELECTION OF PLANT MATERIALS

The selection of plant materials for natural snow fences is governed by factors of site, terrain, and locality. The approach to a town may suggest an avenue of trees, while a distinctly rural section of highway demands a more naturalistic treatment.



PLANTING STRIP AT RIGHT ANGLES TO ROAD ALONG PROPERTY LINE

In choosing between trees and shrubs, certain fundamental theories may be suggested, among them that a combination of air currents plus deflected air currents results in greater velocity than air currents alone. From this theory it might be demonstrated that the greater density or screening effect of trees means greater velocity of air currents, and, where trees are used for snow fences, less piling up of snow on the roads. Snow will not drift under a canopy of trees.

A tree-lined highway or avenue is particularly pleasing when used as an approach to a town or city, or as an approach to or marker for a farmstead entrance, for it suggests both a touch of formality and a sense of orderliness.

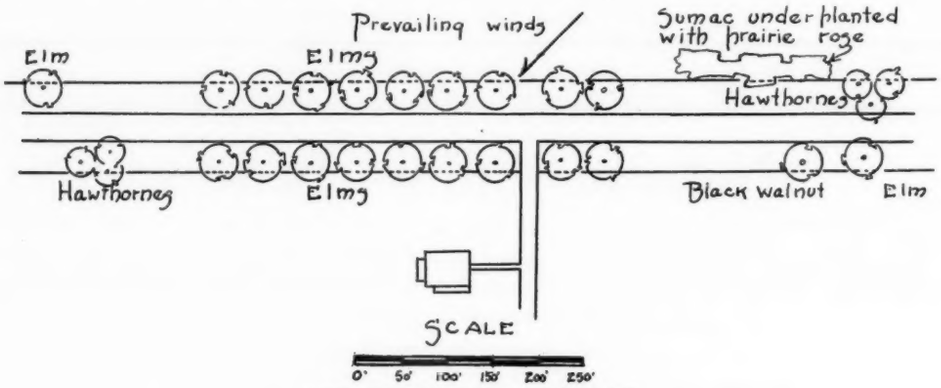
The factor of contour or terrain as a determinant of choice of plant materials for snow fences cannot be over-emphasized. In some sections, where the snow drifts are normally heavy, the pile of snow resulting from its removal from the highway reaches a height of twelve feet or more. It is then that the slat snow fence is entirely inadequate. For the snow fence must be higher than the pile of snow that drifts beyond it or the snow that is cleared from the highway and piled up along the side. Where the drifts are normally heavy and the ordinary snow fence is inadequate or useless, a natural planting of small trees back from the highway may solve the problem of drifting snows. The native hawthorn may be used to advantage, as well as the mountain ash, the wild plum and wild cherry.

Indigenous plant materials are recommended for snow fences either of trees or of shrubs. Aesthetically they are more adapted to the surrounding landscape than the introduced plant materials. Practically they are more hardy and more readily adaptable to the conditions of soil and climate under which they will be called upon to survive.

COSTS

Considering comparative costs, trees may be relatively less expensive than a snow fence of shrubs. The initial cost of plant materials may be the same, although the cost of shrubs for a 300 feet stretch of roadway is usually reckoned greater than the cost of trees (placed fifty feet apart on either side of the road) for the same distance. However, the variability of nursery stock prices, together with varying prices for various sized trees and shrubs, might well equalize their cost.

The greater expense of the snow fence of shrubs lies in securing additional right of way, where that is necessary, so that the shrubs may be set far enough back in the fields to adequately prevent drifting snow on the road. In some instances, it is necessary to purchase such additional right of way, whereas trees can usually be planted within the existing right of way.



UNIT OF ROADSIDE PLANTING
Approach to farmstead. 100-foot right of way, 32-foot roadway

The cost of securing additional right of way is no more prohibitive for purposes of providing a natural snow fence than it is for eliminating a bad curve or making a cut-off. Land values in Wisconsin vary from $30 an acre to $5,000, depending chiefly upon the use to which the land may be put and the proximity of cities. A strip of land 100 x 300 feet, then,

SNOW FENCES STACKED ON CRIBS AT THE SIDE OF THE HIGHWAY DURING THE SUMMER AND EARLY FALL ARE SUBJECTED TO MONTHS OF UNNECESSARY WEATHERING

would be three-quarters the price of an acre. Land secured for natural snow fences is a permanent investment, and should be figured as such. It may be secured either by purchase or condemnation.

Planting costs of natural snow fences need to be calculated, and planting and maintenance costs may be compared with the initial cost and maintenance of artificial snow fences.

The cost of planting a 300 foot strip of highway to trees, the trees being fifty feet apart on both sides of the highway, is figured at $28, or $2 a tree. Maintenance on this for five years will be less than one-half the original investment, or $13.30 distributed as follows: second year, $7.00; third year, $3.50; fourth and fifth years, each $1.40. This averages thirteen and two-thirds cents per linear foot for five years.

The initial cost of planting a 300 foot stretch of roadway to shrubs, setting the shrubs three feet apart on one side of the road, approximates $50 for shrubs and planting. Maintenance is practically nothing and replacement is usually guaranteed by the nursery if the shrubs do not survive after adequate initial care.

The ultimate height and spread of the shrubs determine the planting distances. Large shrubs, such as the elderberry, red dogwood, and arrowwood need to be at least four feet apart to prevent overcrowding and assure maximum development, while the smaller shrubs, as the prairie rose, should be no more than three feet apart. The size of the normal snow drift will determine the type and size of shrub to be used.

The collapsible slat snow fence now in use in Wisconsin costs six to eight cents a linear foot, when purchased in car load lots. The cost of erection and taking down approximates three and half cents a linear foot, figuring a man's time at 40 cents an hour. The initial cost of providing and erecting the collapsible fence for a 300-foot stretch of highway is then $34.50, to which $10.50 must be added yearly for erection and taking down. For a five year period, then, the total cost is $76.50 and the cost per linear foot is 25½ cents. Replacements in toto are figured on a ten year basis, whereas the natural snow fence is relatively permanent and unnecessary to replace.

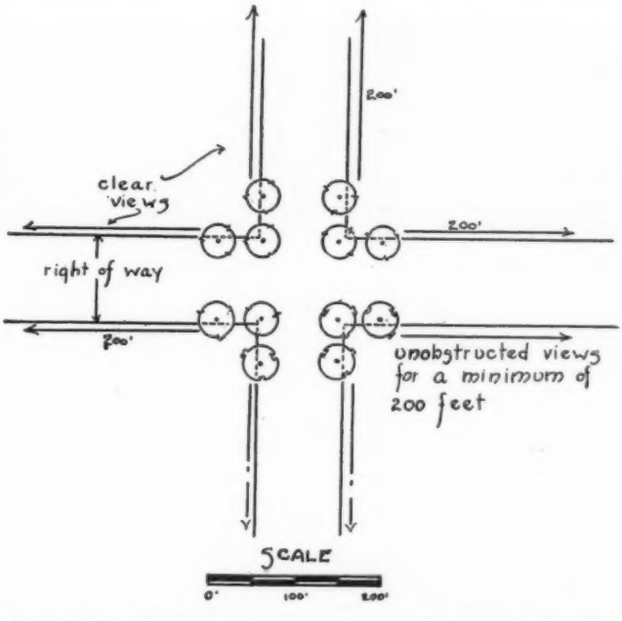
OTHER CONSIDERATIONS IN ROADSIDE PLANTING

Providing natural snow fences is but one aspect of roadside planting. Any stretch of highway that is given over to natural snow fences should be considered as a unit and treated as such. That is, the planting along the highway should be not only for snow drift prevention, but should include such other planting as is necessary for the aesthetic completion of the unit. While shrubs may be most feasible for preventing snow drifts along any one section of highway, the locality or the terrain or both may naturally suggest plantings of trees to complete the picture and to give that aesthetic satisfaction which the mind unconsciously seeks. In prairie country it may be desirable to accentuate any slight change in contour. This may be done usually by planting trees on such knolls or elevations as there are.

Roadside planting is a problem for one with an engineering background who is thoroughly trained in horticulture. The landscape architect is usually qualified to cooperate with the engineer to the end that a unit of highway may have about it a feeling of unity and of harmony, along with the maximum of utility.

For the past eight years, the State Highway Commission of Wisconsin has cooperated with the University of Wisconsin in studying some of the problems of roadside planting. Observations of drifting snows have been made from time to time, along with recommendations for snow fences. Two years ago, a study and complete set of plans was made for planting a five-mile stretch of federal aid highway in Sheboygan county. These plans, together with all of the research in the field of roadside planting, have been under the direction of Professor Franz A. Aust of the Department of Horticulture of the University. Studies of the problems of roadside planting—those of snow drift prevention, of cooperation with utilities companies in their tree trimming programs, of the marking of traffic hazards and intersections, and of the erosion of cuts, fills, and slopes and its possible prevention—have been somewhat limited in scope because of lack of available funds with which to continue scientific experiment and systematic research The research program will go forward as soon as additional funds become available.

The adequate solution of the problems of natural snow fences and of the various other aspects of roadside planting may be arrived at only after further investigation. The solution must combine utility with beauty in order to be compatible with the new aesthetic, expressive of the machine age and the age of power. We now have high-powered motor cars with stream line bodies; we have graceful but fleet airplanes; and we have new expressions in architecture where form follows function in typifying the American tradition and temperament. In roadside planting, the highway engineer and the landscape architect may join the onward march of those contributing to the aesthetic enjoyment of the highways, at the same time that the practical problem of removing drifting snows and that of removing and replacing collapsible snow fences is minimized.



ROADSIDE PLANTING FOR HIGHWAY INTERSECTION, ILLUSTRATING USE OF SIGNAL TREES

Keeping Highways Free From Snow

Equipment used, amount spent and unit costs in the thirty-six states where snow is a factor. Progress during six years, especially in equipment

Thirty-six of the forty-eight states lie in the snow belt, where sufficient snow falls to make it desirable to remove it from the highways. These states are spending more than five million dollars a year in keeping clear of snow about 115,000 miles, out of a total of about 125,000 miles of roads improved with a gravel surface or better.

The wonderfully rapid progress made in this branch of highway maintenance is shown by comparison with the figures for six years ago. During the winter of 1922-'23, only 27,100 miles were cleared of snow, or less than one-fourth the amount cleared last winter. Moreover, this small mileage was not cleared as often or as thoroughly. This last statement probably can not be proved by actual figures, but the average cost per mile of road cleared is now fifty percent more than it was six years ago, although improved methods and equipment must have, it would seem certain, reduced the cost of such work per mile of snow removal done or per cubic yard of snow handled.

The amount of equipment used is the most striking feature in the comparison of 1922 with 1928; the total pieces of major equipment—truck and tractor plows—increased 1,200 percent; and the increase in number of trucks, tractors and graders used for this purpose has probably been as great, although figures back of 1925 are not available.

According to figures furnished by the several state highway departments to the Bureau of Public Roads, the number of truck plows used increased from 184 in 1923 to 3,412 in 1928; the number of tractor plows from 281 to 1,275; while between 1926 and 1928 the number of trucks used in this service increased from 3,943 to 5,239; of tractors from 1,348 to 2,245, and graders from 1,511 to 2,075.

The relative rates of increase of the several types of equipment is significant. During the first three years the number of truck plows increased 1,284%, and of tractor plows only 186%; while during the next two years the increase was 34% for truck plows and 59% for tractor plows. During the same two years the number of trucks increased 45%, tractors 67%, and graders only 37%. These figures show a general move toward heavier equipment, adapted to handling heavier drifts and clearing wider roadways.

Iowa, with an average snowfall of 20 inches, used 149 truck plows and 40 tractor plows; Wisconsin, with an average snowfall of 51 inches, and clearing 2½ times as many miles of road, used 181 truck plows and 116 tractor plows. Also, Iowa used 213 graders and Wisconsin only 59. Here also is seen the tendency to use the heavier equipment for the deeper snow and heavier service. Connecticut had the same average snowfall as Iowa, 20 inches, and used 275 truck plows, no tractor plows and no graders; but it cleared only 28% as many miles of road.

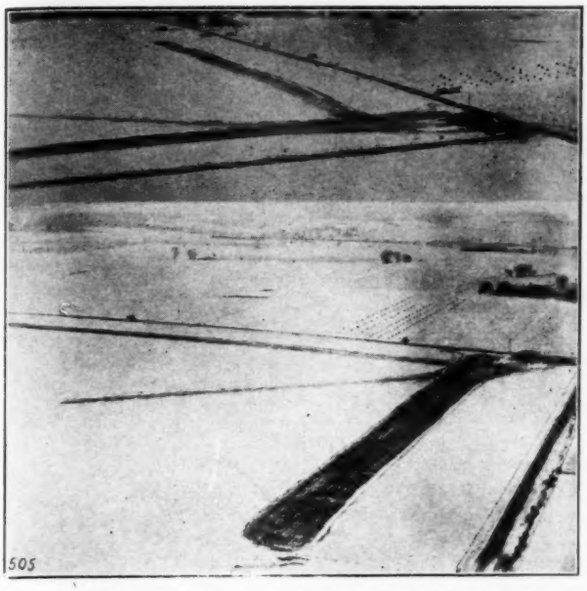
Connecticut's cost averaged about $1.75 per inch-mile (using the total inches of snowfall in the calculation) and Iowa's about $2.20; but the cost per mile of road cleared was nearly equal in the two states. However, much more information is needed to give any value to cost figures. For example, in New York state, Chatauqua county with a 53-inch snowfall cleared 161 miles of road 24 feet wide at a cost of $4.73 per inch-mile; while Cattaraugus county, with a 55-inch snowall, cleared 310 miles 18 feet wide at a cost of $1.52 per inch-mile. And Onondaga county had deeper snow—87 inches—and cleared a wider track—22 to 30 feet—for only $0.68 per inch-mile. The amount of equipment shows even less consistent relation. Of the New York counties reporting, the one with the highest rate used next to the smallest amount of equipment, and the one with the lowest rate used next to the largest amount of equipment; but the one with the next to the highest rate used the most equipment and the one with the next to the lowest rate was second from the lowest in amount of equipment. Relative depths of snowfall or widths of road cleared show equally inconsistent relations to cost. Apparently we have a long way to go in working out units of measurement and methods of cost accounting on snow handling work before figures of cost will mean anything.

In the matter of supervision of snow handling on highways, there has been a steady trend toward state control and away from that by local governments. Of thirty-six states in which snow was removed from highways in 1923-'24, thirteen placed the work exclusively in the hands of the local government; but by 1927 this was the practice in only seven states. On the other hand, control exclusively by the states declined from 21 states to 10 during that period. Control by both state and local governments had increased from 2 to 19 in that year; but by the following year four of these and three states having local government control were added to the list having exclusive state control.

Snow Removal on Airports

Commercial aviation requires that the regular service be continued through all kinds of weather, and this requires not only flying but also taking off and landing under all conditions. Among these conditions is the presence of snow of a depth which would prevent the progress of wheeled vehicles through it at high speed, which means anything exceeding a few inches. For ordinary planes this necessitates cleaning the snow from the runways at airports before it exceeds a depth of two or three inches, and keeping them clean during the fall of snow as well as afterwards.

SNOW-PLOW CLEARING RUNWAY AT CEDAR RAPIDS



TWO AERIAL VIEWS OF CEDAR RAPIDS AIRPORTS WITH THREE RUNWAYS CLEARED OF SNOW

The accompanying photograph shows the airport at Cedar Rapids, Iowa, with the runways cleared for a width of 100 feet or more, from snow which covers the field to a depth varying from 10 inches to several feet. Three runways have been cleared, one 2600 feet in length and the other two 2000 feet each, thus giving six possible landing directions to approaching planes. As can be seen from the photograph, the cleared runways are more plainly visible to incoming planes than is the case when there is no snow on the field.

The other photograph shows one of the runways being cleared by a "Caterpillar" 60 on a La Plant-Choate hydraulic operated "V" type plow. On the next trip down the runway the wing will be raised and the side sloped for safety. The combined length of the three runways, about a mile and a quarter, was cleared with this snow plow in about four hours.

The third cut shows the airport at Spokane at night with an inch or two of snow on the runways—not enough to necessitate immediate removal, although it should not be allowed to freeze in place and give a rought surface.

As stated above, it would seem desirable to follow the practice adopted by state highways and begin removing the snow as soon as it acquired a depth of two or three inches.

Lengthening Culverts In Nebraska

When the Kimball-Harrisburg section of Nebraska State Highway No. 29 was improved in 1918, the roadway was made 20 feet wide; but in 1926 a traffic count showed an average of 838 vehicles per 15-hour day, which seemed to require a wider pavement, and last year the width was increased to 24 feet and gravelled. At the same time low places were raised and curves were widened, the radius of each being increased at the same time from 150 feet to 360 feet and super-elevation being provided permitting making turns safely at 35 to 40 miles per hour.

There were a number of culverts only 20 feet long scattered throughout the 27 miles of road, and the work of extending these to 24 feet was started late in 1928. These culverts had headwalls, as required by the U. S. Bureau of Public Roads in granting federal aid, and it was thought that it would be more economical to move the old headwalls outward than to build new ones. The method of moving these headwalls is described in the July issue of the "Highway Magazine," the organ of the Armco Culvert Mfrs. Ass'n.

The first operation was to excavate down to the level of the bottom of the headwall and for a distance out from the roadway sufficient to permit moving the wall to its new location. Armco corrugated pipe had been used in constructing the culverts, with the ends of the pipe built into the headwalls. It did not seem desirable to make an opening behind the headwall sufficiently large to permit cutting off the drain pipe by hand, and the cutting was done by means of an acetylene torch used from the end of the culvert. The operator, reaching inside the culvert, made a cut following one of the corrugations about 14 inches in from the face of the retaining wall. This cutting was done several weeks before the walls were actually moved, and a small strip of metal was left uncut at the top of each pipe to prevent the wall turning over before it could be moved and backfilled.

No tractor being available as power, the moving was done by hand, a hoist and trolley being designed for that purpose. Two frame bents were constructed, one 7 feet high to rest on top of the grade and one 10 feet high to rest in the ditch. The legs of the bents were constructed with a steel yoke at the top into which was fitted an 8 by 18-inch cross timber, which was firmly fastened in the yoke by means of a one-inch steel pin. Thus, for convenience in handling and moving, each bent could be knocked down into three pieces by pulling these two pins. When these two bents were in place, two 8-inch, 28-pound I-beams, each 16 feet long, were placed side by side resting upon the tops of the bents; two beams being used rather than one so that fewer men would be required for lifting them into place. A home-made trolley was constructed of traffic tread plates and track pins and bearings from a "Caterpillar." The hoist was a one-ton Yale, spur-gear type, weighing 650 pounds, and two quarter-ton chain blocks were used to lift it to place under the trolley.

With the trestle, trolley track, trolley and hoist in place, a small hole was dug down to the pipe on the inside face of the wall. A chain was used on the inside of the wall, one end of which had a pointed steel bar attached to it, which bar was placed on top of the pipe close to wall and driven through the pipe with a hammer. Another chain was used on the outside of

the wall, on one end of which was a clevis fitting the bar and attached to it on the inside of the pipe by means of a ¾ inch steel pin. Each of these chains had a grab hook on the other end, which was fastened to the hoist hook. A short length of 12 by 12 timber was placed between the outer face of the headwall and the chain, and by a little adjustment of this timber, the center of gravity of the headwall could be shifted until the wall would hang vertically, in spite of the two 45-degree wings.

The wall was then raised high enough to swing free of the ground and rolled out the necessary distance. The culvert pipe was then extended by collar-bolting a new section into place, and the wall was lowered to bring it to the proper elevation, care being taken that it was parallel to the road and level. The hole behind the wall was backfilled later by teams; or this was done immediately by hand late in the fall when freezing temperatures were common.

A crew of four men was used and averaged moving three walls per day, not including the backfilling. Several times seven walls were moved in two days; and two walls were moved per day when hand backfilling was necessary.

Typical Sections for California Highways

Typical sections adopted as standards by the California Division of Highways for several widths of highways ranging from eighty feet to development of a two-hundred-foot right of way

By Fred Grumm*

Adoption of standard practice, in so far as possible, for the location upon the right of way of trees, pole lines, and other public utility facilities, is not only desirable but practically imperative if we wish to provide economically for the maximum development and use of the right of way looking toward the greatest service to the traveling public. Realization of this fact led, after considerable study, discussion and conferences, recently, to the adoption of the several typical sections for various widths of right of way. These typical sections will be found illustrated on another page. They may be briefly described as follows:

(1) A typical roadway grading section for use on valley roads;

(2) A typical section showing utilization of 80-foot right of way;

(3) A typical section showing utilization of 100-foot right of way;

(4) A typical section showing progressive development of roadway and utilization of 90-foot right of way for state highways adjacent to railroad lines;

(5) Sketch showing plan for development of state highways providing for through traffic and later local traffic as abutting property passes through several stages of use. Minimum development using ultimate 160-foot or 170-foot width right of way.

(6) Sketch showing plan for development of state highways providing for through traffic and later local traffic as abutting property passes through several stages of use. Maximum development using ultimate 200-foot width of right of way.

The first, a typical roadway grading section for use on valley roads, is so designed as to eliminate borrow pits, substituting therefor a "turnpike section," providing for taking all available excavacation material from within the right of way for the construction of the standard 36-foot width of roadbed and still remaining within the lines and limits of the ultimate 56-foot development. It is to be used, wherever applicable, in valley or easy country on programmed projects which are being or will be prepared for future improvement. It is particularly applicable to construction and reconstruction projects on routes 3, 4 and 7 in the San Joaquin and Sacramento valleys and on large portions of route 2.

An inspection of a number of the layout plans and cross-sections in the valley country indicate that: (a) The average cut bank near the right of way line is less than two feet; (b) imported borrow is often needed for a 36-foot roadbed; (c) the full utilization of excavation material within the right of way, as indicated on the section, will usually not result in waste in the construction of a 36-foot roadbed—in fact often will not make the fills and therefore additional imported borrow is necessary.

The section was developed to make use of all of the excavation within the right of way for the construction of the present 36-foot roadbed and was designed so that no excavation would be made below the subgrade elevation of the future 56-foot pavement. Provision is made for taking care of surplus excavation which might develop at certain points. This is to be placed in embankment having slopes similar to those in excavation and to a subgrade elevation for future pavement.

The use of this section in the flat country will provide flat slopes beyond the shoulder of the roadbed, extending in excavation practically to the right of way line, and consequently making this portion of the right of way more easily accessible for maintenance purposes. Where it is definitely known that abutting property is subject to early improvement by subdivision and the construction of business or semi-business buildings, excavation and embankment can be made, as indicated on the typical section, to provide for placing of curb and sidewalk.

The second typical section shows the utilization of 80-foot right of way. The proper placement of the trees and pole lines is shown which permits of future development of the roadbed to an ultimate 56-foot width.

The third typical section shows the utilization of 100-foot right of way, on which is indicated the location of trees, pole lines, and sidewalks. This section is also designed to permit the construction of an ultimate 56-foot pavement.

The fourth typical section shows the utilization of 90-foot right of way for state highways adjacent to railroad lines. It has been primarily designed to care

*Engineer of Surveys and Plans, California Division of Highways.

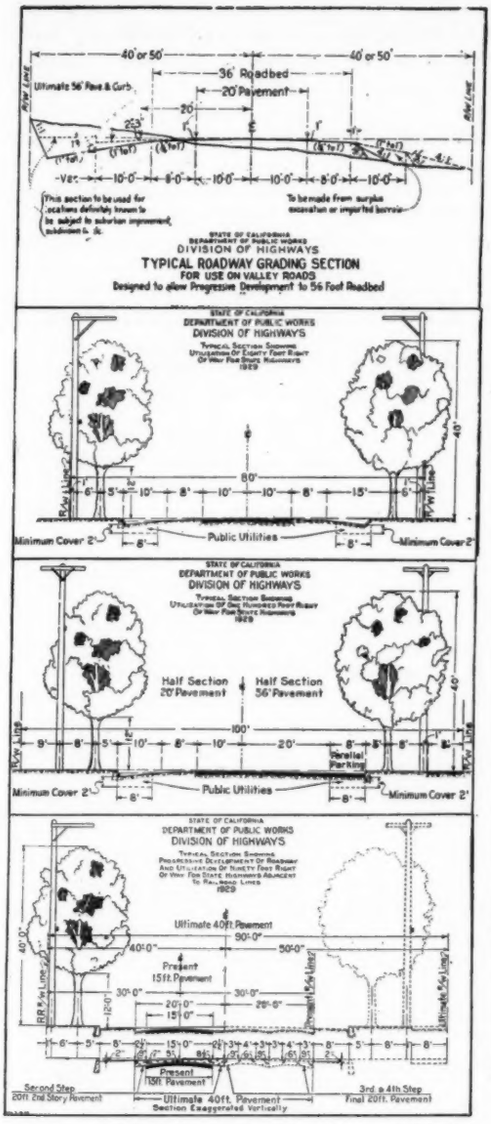
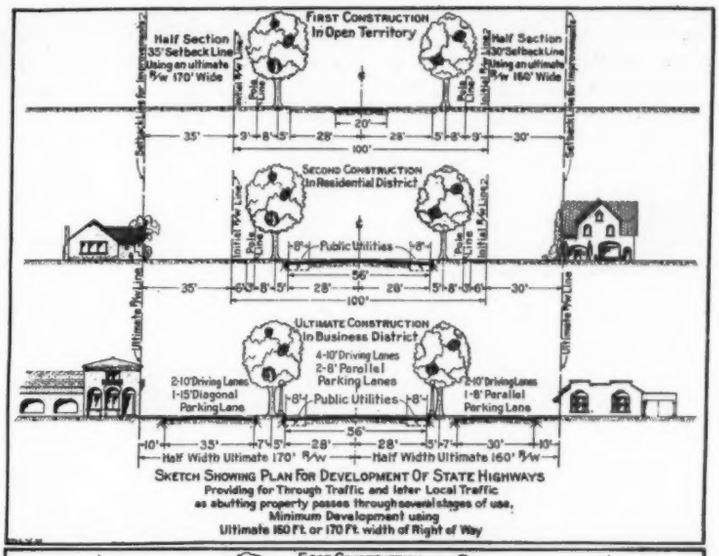


FIG. 1—TYPICAL SECTION FOR VALLEY ROADS
FIG. 2—UTILIZATION OF 80 FT. RIGHT OF WAY
FIG. 3—UTILIZATION OF 100 FT. RIGHT OF WAY
FIG. 4—PROGRESSIVE DEVELOPMENT OF 90 FT. RIGHT OF WAY



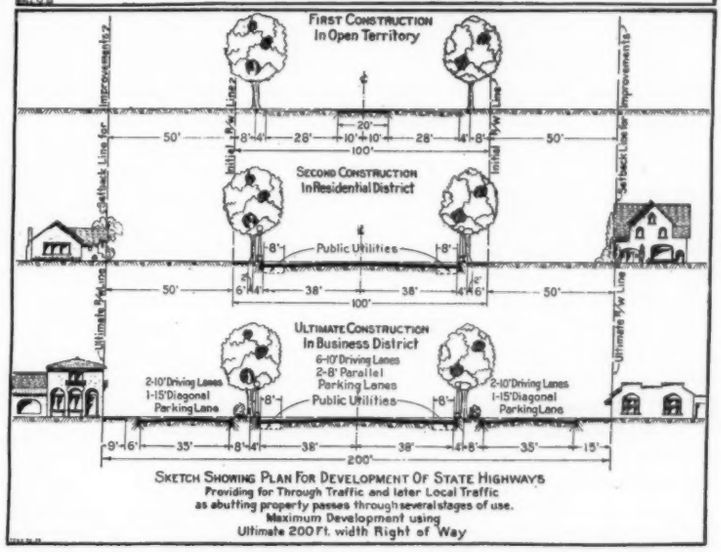


FIG. 5—DEVELOPMENT OF 160 TO 170 FT. RIGHT OF WAY
FIG. 6—DEVELOPMENT OF 200 FT. RIGHT OF WAY

for the reconstruction and widening of our present narrow pavements in such locations, looking toward ultimate future development of the 56-foot width in a progressive manner without incurring the loss or reconstruction of the first stages of the work. It embodies the idea of sloping the 20-foot pavement, undertaken as the first reconstruction step, in one direction, permitting the addition of future widening without disturbing this original construction.

It is obvious that this method of development preserves the original 15-foot pavement without loss, permits the addition of resurfacing where flush shoulders have been constructed on the old 15-foot pavement, permits the second and third step of development without loss of previous installation or thickening of the same with the attending necessity of continually raising the grade.

Since on the railroad side no development of property is possible, sidewalk space has been omitted, and only sufficient space between the ultimate curb line and the right of way line is provided to place trees and poles. On the opposite side away from the railroad right of way, the same space is provided as on the typical section for the 100-foot width of right of way.

The fifth typical section shows a plan for developing the state highway to an ultimate 56-foot width for through traffic, and by use of setback lines to provide for the later construction of side roads or local service lanes as the abutting property develops.

This plan shows two half-width sections; one for an ultimate 160-foot right of way, the other for an ultimate 170-foot right of way; the difference between the two being in the width of the side road or local service lane, which on the 160-foot right of way is 30 feet in width, consisting of two 10-foot driving lanes, and one 8-foot parallel lane, and on the 170-foot right of way of a 35-foot side road or local service lane, consisting of two 10-foot driving lanes, and one 15-foot diagonal parking lane.

The ultimate development as shown provides a 56-foot width for through traffic, designed on the basis of four 10-foot driving lanes, and two 8-foot

parallel parking lanes, with the local service lanes, previously described, separated from this through traffic road by parking strips 12 feet in width on which trees and light standards may be placed. It is to be noted that trees which may have been planted during the first construction, will remain undisturbed in the progressive development to the ultimate construction. This section may be considered the minimum development in territory which may be improved and become a business district.

The sixth typical section shows a plan for developing state highways to an ultimate 76-foot width. This is accomplished by establishing 150-foot setback lines from the original 100-foot right of way. This width will provide, in the future when abutting property develops into a business district, for a 76-foot road for through traffic, consisting of six 10-foot driving lanes and two 8-foot parallel parking lanes and local service roads on each side, 35 feet in width, consisting each of two 10-foot driving lanes and one 15-foot diagonal parking lane. These local service roads are separated from the through road, as in the previous section, by 12-foot parking strips.

This last section may be considered the maximum development and probably will apply only to a small mileage of the state highway system.

The various features outside of the roadway section surfacing or pavement, such as the various public utilities, pole lines, trees, etc., are placed upon the right of way under permits issued by the Division of Highways. These typical sections indicate the definite location for these various features and will provide that their installation under permit in the future will insure not only sufficient room for the development of our proper roadbed section, but will also obviate the necessity for their removal whenever widening or improvement of the road is undertaken.

The adoption of these definite sections permits the carrying out of a well formed policy relative to stage construction of the highway in an orderly, economical, progressive development keeping pace with the traffic requirements and leading to the ultimate development therein illustrated.

Note: For the above we are indebted to "California Highways and Public Works," the official journal of the Division of Highways, State Department of Public Works of California.

Road Building in Turtle Mountain Indian Reservation

This reservation occupies all of two townships in North Dakota. The topography is not really mountainous but the reservation consists of low glacial hills. Here live 2,100 Indians, including 750 of school age. Such district schools as there are, are crowded, being too small to accommodate all the children, and with the poor trails on the reservation, travel to and from school is difficult under winter conditions. It was therefore considered advisable to build a consolidated school and provide buses to transport the children; which would necessitate a loop system of roads for use of the buses, so located as to pass within one mile of any Indian residence. It is expected to build gravel roads with a crown width of 14 feet, using about 600 cubic yards of gravel per mile. The system as laid out will require the construction of about 40 miles of such road. Congress made an appropriation for the school and the roads, with the proviso that Indian labor must be employed. For this reason the day labor method seemed to be necessary. Another unusual feature of this road is that the surveying—running out the necessary lines and levels, making profiles, establishing grades and setting grade stakes—will be performed by a light party of three or four men with an engineering student of the University of North Dakota at its head, their work to be under the general supervision of an engineer of the Bureau of Public Roads.

The Problem of Inexpensive Low-Type Roads*

Surface treatment to provide inexpensive high-speed roads applicable to eighty-eight percent of all the improved roads of the country

I am going to venture today to lay before this audience some details of our national road program which should receive your attention and which, I think, can be made profitable both to you and to the nation-at-large. Let us consider for a moment a rough inventory of our national highway system, and by this I do not mean only the Federal Aid highway system which comprises not more than seven percent of our total mileage; nor do I include only state systems which probably do not exceed 12 percent of the total mileage, but I refer to our national road system as a whole, with its hundreds of thousands of miles of dirt roads, its tens of thousands of miles of sand-clay, top-soil and gravel, and its nucleus of high-type construction which is still discontinuous, irregular and correspondingly inefficient. The total mileage of public roads in the country is undoubtedly about three million miles. According to the latest available reports this mileage is distributed in accordance with the following table:

Type	As of January 1, 1927		
	State Roads	Local Roads	Total
Graded and Drained	28,456	598,803	627,259
Sand-clay and Top Soil	11,396	69,711	81,107
Gravel, etc.	79,286	245,524	324,810
Waterbound Macadam	18,428	42,732	61,160
Bituminous Macadam	12,927	11,651	24,578
Sheet Asphalt and Bituminous Macadam	5,706	5,155	10,861
Portland Cement Concrete	31,936	10,405	42,341
Brick	3,216	1,384	4,600
Asphalt Block	88	319	407
Other Types	77	124	201
	191,516	985,808	1,177,324
Unimproved	96,413	1,726,454	1,822,867
	287 929	2.712,262	3,000,191

This table is an inventory of our national highway system today and when analyzed, it has some aspects which I think should be very interesting to the oil industry. Note first that there are 1,822,867 miles of roads still unimproved. Of the improved roads, over 600,000 miles are graded and drained only and have no surfacing of any kind. Over 300,000 miles are of gravel, very little of which has been surface-treated.

*From a paper before the Asphalt Paving Confernce entitled "Possibilities in the Use of Cut-Back and Other Asphaltic Products," by E. W. James, chief, Division of Design, U. S. Bureau of Public Roads.

The total mileage of types below waterbound macadam represent over 1,000,000 miles, or approximately 88 per cent of all improved roads. Waterbound macadam, most of which has undoubtedly been surface-treated, and bituminous macadam represent another 85,000 miles, or approximately 7 per cent of the entire improved mileage.

It is the group of low-type improved roads represented by gravel, sand-clay and graded and drained earth, that furnishes one of the most serious problems facing the highway engineer and the several states at the present moment. These roads have been improved under a variety of conditions and, apparently at the time the work was done, the improvement was adequate for the existing traffic. There is a powerful and effective force of public opinion directed toward the improvement of a large mileage and this unquestionably is going to be effective for many years longer. This will encourage the continued construction of low-type roads.

Along with this condition, however, we have another just as certain and imperative, and that is the constantly increasing traffic. Many states in the semi-arid and arid regions have built graded and drained roads and light gravel surfaces which were expected to furnish highway service throughout the year. This result has been secured, but at a heavy cost. It has been found that quantities of material lost by reason of the dry climate and high winds, which may fairly be assumed to increase the deterioration of many of these gravel roads, actually cost more to replace per year than it would cost to oil the surfaces. The earth roads remain serviceable except for the occasional periods of rain when the thirsty soil, dry, porous and avid for moisture, turns the road surfaces, frequently hard though dusty, into impassable mud. But in the dry season the regions where these roads predominate are plagued with a dust nuisance, which twenty-five years ago, with the advent of the automobile, was considered a sufficient incentive for improving the roads which then existed. This dust nuisance is still very real in large parts of our country. The State of Nebraska has built approximately 3,600 miles of gravel in a total improvement on the State and Federal Aid systems of 4,100 miles of road. The state is out of the mud, but in the dust and, at some seasons, the dust is so bad as to constitute a driving hazard for motor traffic. The large and important problem to us is to devise ways and means for raising these low-type roads to a condition where they will be dustless and reasonably water-proof. This is the first phase of the problem wherein should lie the interest of the oil industry.

It is a problem (not so paradoxical as it may sound) of providing inexpensive, high speed roads. It is not essential that they be of great durability, since for the most part they will lie in areas where traffic is relatively light both in quantity and in type of units. It was only about two years ago that the question of inexpensive, low-type roads received for the first time serious attention from the point of view of the present demands. A project was instituted by the Highway Research Board, The Asphalt Association and the American Road Builders' Association to study types and the development of low-cost construction.

It is clearly indicated as a result of these studies and of others by the Bureau of Public Roads, as well as by the states of Illinois, Wisconsin, Minnesota, Oregon and California, that the use of oil products promises the most successful and inexpensive methods for raising these low-type surfaces and improvements to a condition satisfactory to meet the public demand. Scattered here and there throughout the country we find determined efforts at oiling earth roads, for placing mats of oil and sand, or oil and fine cover material on sand-clay roads, and for surface-treating gravel roads. More ambitious efforts have evolved methods of processing crushed gravel and fine, crushed-stone road surfaces in the Far West. We have developed double surface-treatments, retreading methods which are classified by A. H. Hinkle of the Indiana Highway Department into the four following groups,—ordinary surface-treatment, mulch mixtures, retread tops and penetration tops.

In all of this sort of work, the only method which experience assures us to be generally satisfactory is the surface-treatment of waterbound macadam by either the single or double application. The engineer is not certain of good results when he attempts to oil earth or sand-clay roads. The application of surface-treatments to gravel and the so-called process methods, developed in parts of Indiana and by two or three western states, have not yet shown complete dependability.

Treatments of this sort are applicable to approximately 88 percent of our entire improved road system, and if we include the necessary resurfacing of surface-treated macadams and the resealing of bituminous macadam, it applies to not less than 95 percent of all the roads so far improved. *The development of a method or methods for performing this work successfully and of furnishing materials so graded and specified that satisfactory results may be depended upon, is unquestionably the largest single problem confronting the highway engineer today* and it furnishes a field for industrial expansion in the oil industry of the very greatest possibilities.

Using round figures for convenience, we find that there are 24,000 miles of bituminous macadam in our present highway inventory. Most of this will have to be resealed or retreated at least once in five years. This gives us an annual retreatment program of 4,800 miles. We have approximately 61,000 miles of waterbound macadam in our national highway system. Probably a very large part of this has been surface-treated, but we will be conservative and estimate that only 50 percent of it is so treated, or approximately 30,000 miles. Of the gravel roads it is doubtful if more than a small fraction has been surface-treated because of the difficulties experienced with this type of application. If we liberally assume that ten percent of the 325,000 miles of gravel roads are already treated, we shall have a balance of approximately 292,500 miles requiring treatment.

Bituminous applications on earth and sand-clay are almost negligible inasmuch as the work has been confined to a few scattered localities. Let us say that two percent has been treated out of a total of 708,000 miles in our inventory, and we have a balance of 694,600 miles subject to treatment.

From the great network, 1,825,000 miles of unimproved road, a certain fraction will be advanced into the improved class annually but we may exclude this for the time being inasmuch as we still shall find plenty of work in sight. Our annual program of resealing

and surface-treating is set up in the following table with a total of approximately 1,022,000 miles of road:

Type	Miles
Bituminous Macadam	4,800
Waterbound Macadam	30,000
Gravel	292,500
Graded Earth and Sand-clay	694,600
Total	1,021,900

Expansion Joints in Concrete Roads*

Nature of defects in joints, and correct methods of constructing them.

The Portland Cement Association started about a year and a half ago a study which, for the want of a better name, was called a condition survey of concrete roads. Progress today indicates that three additional years will be required to complete this study. In the study all features of design, methods of construction, materials, climatic conditions, service and traffic and all of the other significant variables are being taken into account.

The field party consists of five men equipped with an automobile with some special appliances including an instrument for measuring the surface smoothness of the pavements. In some cases by permission of the state highway departments we are removing cores from the roads for study. The cores of one series have been cut into one-inch thicknesses in order to study separately the condition and character of the concrete at various depths. A careful and detailed study is being made with the hope that something that will be of benefit to the road designer and builder, and to the road user, and the man who pays for the road will be developed. The field observations have been completed in one central state, one southern state, and one northern state. These three states were chosen because they involved different phases of the study, in hope that in such a preliminary investigation something of benefit in carrying on the balance of the investigation would be found.

There is also evidence tending to establish the necessity for more complete understanding of details of placing expansion and other joints in the pavement. In one study 40 per cent of the expansion joints used in the original construction were found to be defective principally through careless construction. The joints were:

(1) Not vertical.
(2) Did not extend through entire thickness of pavement.
(3) Did not extend entirely across the pavement.
(4) At intersection of compressible and non-compressible joints, the compressible joint filler did not extend continuous across non-compressible joint.

All of these defects which contribute so largely to the surface maintenance required on the pavement should and can be totally overcome by proper installation during construction.

Care should be exercised to prevent foreign materials of a solid nature from becoming lodged in the space to be occupied by the joint filler and all such materials should be removed before joints are refilled with bituminous material during maintenance operations.

The application of bituminous material to the outside edge of the pavement slab at the outer ends of expansion joints has been found to be effective in preventing foreign materials from entering the expansion joint from the side. This result is most easily accomplished by removing shoulder material at the ends of all joints for the full depth of pavement slab and inserting sheet metal or other suitable form to mold a section of bituminous material about 1 inch in thickness and from 3 to 4 inches in length for full depth of the pavement slab. After the bituminous material has cooled the form may be removed and shoulder material replaced.

It was noted in several instances that short longitudinal cracks in the pavement originated at transverse expansion joints and investigation established the fact that solid materials were imbedded in or were occupying part of space intended for compressible joint filler and when the pavement came into compression excess stresses were set up at these joints resulting in the formation of longitudinal cracks.

The unsatisfactory conditions resulting from non-vertical joints and uneven height of concrete on opposite sides of expansion joints are too well known for discussion here.

The conditions existing at the intersection of compressible and non-compressible joints as observed in the field indicates the necessity for more careful attention to details of construction at these points if maintenance costs are to be held at a minimum.

It was found that in many cases compressible joint filler was cut or short sections omitted to permit installation of continuous section of non-compressible joint material resulting in conditions favorable to spalling and as a consequence requiring additional attention and expense for maintenance at these points.

A good rule to follow would be "Compressible joint filler shall be so installed as to provide continuous strip across full width and depth of pavement and shall be continuous across all joints where no compressible filler is used."

Concrete adjacent to all joints should be rounded by use of appropriate edging tool to prevent chipping.

The replacement of bituminous materials that may be lost from expansion joints under service conditions and the filling and sealing of cracks and breaks that may occur in concrete pavement constitute the major maintenance activity common to the pavement structure.

All cracks and joints should be thoroughly cleaned and old filler and other foreign substances removed before new filler is applied. Steel rods with curved sharp points will be found useful in removing imbedded material from cracks and joints. Small hand bellows are useful in blowing dust and other fine materials out of joints. A hose attached to the exhaust pipe of an automobile may be similarly used and some Highway Departments employ a small portable air compressor mounted on a truck for this purpose.

A hot shovel may be employed to remove excess filler after joints and cracks have been filled. This

*From a paper entitled "Concrete Pavement Maintenance" by Lee S. Trainor, Portland Cement Ass'n., before the Eighth Annual Meeting of the Highway Research Board.

procedure not only produces a more sightly appearance but conserves filler material, and improves the riding qualities of the pavement.

Asphalts and tars predominate as materials for use as crack fillers. However, there are wide differences of opinion among highway engineers as to the relative merits of these two materials as well as many variations of each, which condition suggests the necessity for well directed research in this field.

Specifications for bituminous joint and crack filler have been prepared by A. S. T. M. (Tentative Standard D-102-24 T) and by A. S. M. I. (Page 496, proceedings 31st Annual Convention 1925-1926). However, neither of these specifications seem to meet with universal approval.

Intelligent use of planes of weakness or dummy joints both longitudinally and transversely has eliminated much if not all intermediate cracking with its attendant call for maintenance.

Planes of weakness may be produced by inserting at the time of construction continuous metal or other non-compressible strips set vertical and extending from sub-grade to or near the top surface of the pavement or the same effect can be secured by building the pavement part at a time using properly spaced construction joints for this purpose.

Dummy joints are formed by pressing or inserting into the surface of the pavement (while plastic) a thin metal strip about ¼ to ⅜ inch in thickness and from 2 to 3 inches wide, which strip is later withdrawn leaving an indentation in the surface of the pavement which is later filled with bituminous filler.

Road to Boulder Canyon

Discussing the subject of roads through the desert sections of California, J. T. Baumgartner, member of the California Highway Commission, said recently that by no means the least important work now being carried on by California is that being done on the route which connects southern California and Boulder Canyon. "In order that southern California may reap the full advantage of the many million dollars that will be expended in the construction of Boulder Dam, the California Highway Commission and B. B. Meek, director of the Department of Public Works, have given orders for full speed ahead in the improvement of the highway which connects southern California with this monumental project. Officially, the road connecting Boulder Dam and southern California is Route No. 31 of the state highway system, with its termini designated as San Bernardino to the Nevada line near Jean. Popularly, the road is known as the Arrowhead Trail. It connects the California highway system with the Nevada state highway system leading to Las Vegas, which in turn extends to Boulder Canyon."

So far the California Highway Commission has allotted $1,180,000 to this highway and it may be that more will be required. The amount allotted for the two years beginning July 1, 1929, was $768,000. The budget provides for grading and surfacing with oiled rock 22.3 miles of the highway, for major alignment improvement on 6.5 miles, and for rebuilding two bridges. The road is to be surfaced with oil-treated crushed gravel or stone. The completion of this program will leave 60 miles of the 188 miles of the road unimproved, but the state plans that the unimproved section shall be put in a condition to satisfactorily serve travel pending its more permanent improvement. In this unimproved section the natural surface will be oiled to lay the dust, and certain sections where the surface is rough because of rocks, will be treated with selected gravel; and dragging will enable a smoother surface to be obtained over all of the unimproved mileage.

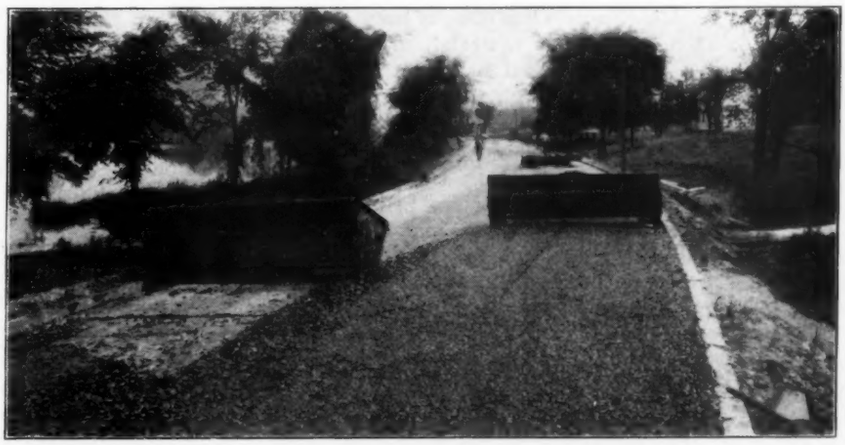
Asphalt on Ontario Roads

Methods of surface-treating roads. Greatest yardage of late has been of asphaltic mixed macadam

In Ontario, Canada, road oils are used as a means of preserving the gravel fully as much as for laying dust. Gravel pits which ten years ago seemed to have an unlimited supply have already been worked out or abandoned and unfortunately the major portion of the material has been blown away, a total loss.

The practice in Ontario is to build gravel roads approximately 30 feet wide, gravelling from shoulder to shoulder and keeping the crown as flat as possible. A gravel float of 1½ inches depth is maintained, providing sufficient loose material to permit dragging and manipulating without matting. In applying road oil, in general, a quarter of a gallon (Imperial gallon, equivalent to about 1.2 United States gallons is referred to) in two applications is used, although this varies with the class of gravel road. Ontario has found a low viscosity, non-volatile, non-asphaltic type gives the best results, the idea being to use an oil that will stay moist as long as possible.

On crushed gravel or traffic-bound macadam roads, where the traffic exceeds 750 vehicles a day, the mulch



SPREADER-BOXES BEING USED BY DEPT. OF PUBLIC HIGHWAYS OF ONTARIO FOR LAYING ASPHALT MACADAM (MIXED TYPE) NEAR WELLAND, ONT.

No detours during construction. Width of pavement, 20′ on tangents; depth of pavement, average 5½″. Old road was thin layer of waterbound macadam over difficult clay subsoil. Pavement was laid in 1925.

method is used. Approximately two inches of loose material varying in size from 1½ inches to dust is applied and traffic allowed to use it for a short time to permit partial dust removal. Medium asphaltic oil containing approximately 70% asphalt base and 30% crude water white distillate is used, being slightly heated in the distributor so that at time of application it will have a temperature of about 150 degrees. Stone is spread uniformly about two inches deep over the whole road. The right half of the road is then penetrated with ½ gallon per square yard. Then the left half of the road is penetrated with ½ gallon, while the right half stone is being graded towards the center. Then the right half is primed, while the left half is being graded to the center, ¼ gallon being used in priming. The left half is then primed while stone is being moved to the right side of the center in a windrow. The stone is then divided and spread uniformly over the road surface, dragging being continued until the surface sets up, about four days being required, depending upon the weather. Finally a surface treatment of ¼ gallon with chips at the rate of 15 pounds per yard is applied. About 11,000 gallons per mile are required for the three applications, the oil costing about 12¼ c per gallon delivered. The cost of oil, distributing and grading, but not including the stone, amounts to $1,700 a mile.

Ontario makes extensive use of surface-treating materials varying from 40% to 80% asphaltic base. In surface treatment, it is specified that half the road be treated in June and the other half during October; which can readily be done, as most of the surfaces on the macadam and bituminous penetration roads run 21 feet wide. Eighty per cent oil and frequently 60% oil is heated before spraying. Immediately after the road has been treated, chips or gravel are applied at approximately 20 pounds to the square yard.

As an alternative to ordinary asphaltic road oil, the province has been experimenting during the past two years with asphalt emulsions, in surface treating macadam and bituminous penetration roads, in the construction of bituminous penetration, and also in the coating of asphalt or penetration roads with a view to providing a non-skid surface. In surface work it has the advantages that it can be applied under either wet or dry conditions and does not pick up readily, but there is the question not yet determined as to its life. Success has not yet been attained in using it as a penetration material, although this may be because the stone used has been a two-inch stone while a smaller size might give more satisfactory results.

A non-skid surface is obtained on sheet asphalt or penetration surfaces by forming a carpet coat approximately ½ inch deep, the surface being painted and a fairly heavy treatment of ⅝ inch chips being rolled on; a second application of the emulsion is made, after which the surface receives a second coat of ⅝ inch and ⅜ inch stone chips, the whole being rolled lightly.

The heaviest yardage of asphalt construction laid during the past two or three years has been of "asphaltic mixed macadam." The original aim in this treatment was to improve on the construction of penetration and at the same time provide a surface that could be built without detour or inconveniences and that would be moderately priced. The pavement is said to meet these requirements, while its non-skid surface recommends itself to the motorists, the riding qualities being those of a high-class gravel road. The stone used runs approximately 20% passing a two-inch and retained on a one-inch ring, 40% passing one-inch and retained on a quarter-inch, and 40% passing a quarter-inch screen. This stone as it comes from the crusher is charged directly into the asphalt plant, where 4.75% of asphalt by weight is added and the mixture is spread upon the road with Burch or Galion spreaders; after which the pavement is consolidated. The completed surface is made about 6 inches thick in Ontario, although the depth depends largely upon the strength of the old subgrade. The contracts are let on a tonnage basis and the engineer is expected to use his own judgment in deciding upon the treatment. Approximately 400,000 tons of mixed material of the above nature were placed on trunk road surfaces in Ontario in 1928.

After the pavement has been thoroughly rolled, or just before final consolidation, ⅜ inch stone chips are applied. Traffic is then permitted to pass over the road for a short period, following which the surface is treated with 60% asphaltic road oil, approximately 1/3 of an Imperial gallon per square yard, followed by a second application of chips, the quantity of chips depending upon the closeness of the surface.

The above description is an abstract of a paper by R. M. Smith, deputy minister, Ontario Department of Public Highways, before the Seventh Asphalt Paving Conference. Referring to the mixed macadam pavement just described, Mr. Smith said that, while it is not claimed to be a pavement of the highest type, it serves a real purpose in supplying one that can be laid under traffic and under almost any condition. "An unsettled grade is not a serious detriment, as an additional levelling-up surface can be added at any time to bring the road back to grade. The pavement, when completed, provides a surface more or less permanent in type and suitable to carry traffic for many years." Some engineers have contended that the pavement would not be dense enough, but this is found not to be the case. Others anticipated that it would require resurfacing every year, but as a matter of fact one section laid in 1921 had received no attention whatever at the end of 1928 and had the appearance of not requiring treatment of any kind for years to come. The province had completed 170 miles of this pavement at a cost in 1928 of $5.90 per ton, or $5.25 where local stone could be used.

Concluding, Mr. Smith said: "In our province this type of pavement would not have been a success had it not been for the cooperation we received from our contractors. While I appreciate that many times we look on the contractor with suspicion and watch him pretty closely, yet will I say that in our province the contractors worked with us. Many of the contractors have engineers on their staffs and they have been generous with their time. They have made the last type of pavement which I have mentioned and which, as I say, we consider the most important type of asphalt pavement we are laying, a real success."

Bridges Surveyed in New Mexico

A condition and statistical survey of all the highway bridges in New Mexico is now under way. To date five hundred bridges of the state's highway system have been listed, measured, reported upon for condition and photographed. When the survey is com-

pleted, complete data on every bridge in the state will be on file for the reference of bridge engineers of the New Mexico Highway Department. These reports will be kept up to date. It is claimed that should a bridge in an out-of-the-way place be washed out, by reference to this file, orders for material can immediately be placed, and fully equipped crews rushed to the job with exact knowledge of what they have to do.

Setting Wire Rope Guard Rails

At the eighth annual meeting of the Highway Research Board, a report on guard fence research was made by the committee on Character and Use of Road Materials. This report states, among other things, that from a series of field tests made by the Pennsylvania Highway Department, failures of wire rope guard fences had been found due to lack of careful construction and inadequate fixtures and attachments.

In discussing this report, H. L. Whittemore, of the U. S. Bureau of Standards, called attention to the necessity of properly attaching the wire rope to its anchorage. Mr. Whittemore's discussion was as follows:

Wire rope is widely used for guard rails for highways, the rope being secured at frequent intervals to posts. The ends of the rope are anchored at each end of the rail.

It should be obvious to anyone that the strength of the rail depends greatly upon the strength of the anchorage because the tensile load in the rope caused by vehicles striking the rail is transmitted in large part to the anchorage. It is in all probability impracticable to secure the rope at each post so that loads are not transmitted to the anchorage.

Assuming that the anchorages will not move under the action of forces which will break the rope, the strength of the guard depends very largely upon the strength of the fastening used to attach the rope to the anchorage rather than the ultimate strength of the wire rope. If the rope is socketed with zinc by skillful workmen the strength of the fastening may exceed the strength of the rope. The tensile strength of wire rope is usually found by testing specimens having socketed ends. Although this is the strongest way to fasten wire rope it does not seem to have been used to any extent for highway guards.

It seems highly desirable for highway engineers to consider having the ropes socketed by the rope manufacturer and use turn buckles or equivalent devices in attaching the ropes to the anchorage.

The ropes for many highway guards are fastened by passing the end of the rope around a thimble attached to an eye in the anchorage, doubling the end back upon the standing portion of the rope and securing with clips.

Although fastening wire rope with clips requires little skill and the fastening can be readily inspected, the rope is likely to slip, the clips frequently crush and bruise the rope and the strength of the fastening is usually less than 80 per cent of the strength of the rope.

Information on the strength of these fastenings can be found on page 8 of Technical Paper No. 237 of the Bureau of Mines "Safe Practice in Using Wire Rope in Mines" by Hood and Kudlich.

The following table gives some of the results:

Number of Clips Required to Make a Fastening Having 80 Per Cent of the Strength of 6 by 19 Plow Steel Wire Rope

Diameter of rope—inches	No. of clips	Efficiency of fastening per cent	Efficiency of each clip per cent	Length of wrench inches
¾	5	77.39	15.5	18
⅞	5	79.13	15.8	18
1	5	77.89	15.6	24
1⅛	5	80.00	16.0	24
1¼	6	82.15	13.7	24

The distance between clips should not be less than 6 times the diameter of the rope. For wire rope smaller than ¾ inch diameter, at least 4 clips should be used. For wire ropes larger than 1¼ inches, it is preferable to socket the rope and avoid the use of clips.

The clips should be inspected frequently and the bolts tightened, if they become loose, as the rope stretches. Probably few highway guards receive the inspection and care that will maintain the efficiency of fastenings made with clips.

Casual inspection of wire rope guards in some of the New England states, particularly Massachusetts, during the past summer leads to the belief that two or three clips are often used when double the number are required. The cost of the additional clips would be a negligible percentage of the cost of an installation and should not stand in the way of making fastenings which are as near the strength of the rope as possible.

There is need of much more information on wire rope fastenings than is available at the present time.

A wire rope clip consists of two parts, the U-bolt and the forged steel "roddle" or base. When making a wire rope fastening the roddle should be in contact with the long end of the rope and the U-bolt in contact with the short end. The catalogs of wire rope manufacturers emphasize this point by illustrating the correct and the incorrect way to attach clips. Probably most of those seen on our highways are attached incorrectly. Apparently the number of clips on highway guards and the way in which they are attached are left to the whim of the workman. Even if for highway guards it could be proven that the way in which the clips are attached makes little difference, our highways are a great educational influence and should not be allowed to teach unsafe practices which it is impossible to counter act by the efforts of safety organizations. If we are to be successful in our efforts to establish and maintain safe conditions in this country each of us must make sure that he does not encourage unsafe practices by others.

It is believed that if the importance of attaching wire rope clips correctly is brought to the attention of highway engineers, the present situation will soon be remedied.

Last "Bump Gate" Disappears from Southwest Highways

The old fashioned "bump gate" pivoted in the middle and opened by wagon tongue or auto bumper has been removed from New Mexico's highways to give way to a modern steel rail cattle guard. With the passing of the bump gates New Mexico highways have had eliminated the last archaism from the ten thousand miles of their length. The list of old fashioned highway structures which are no longer seen include covered bridges, toll bridges and roads, ferries and bump gates.

Lawton's Activated Sludge Plant*

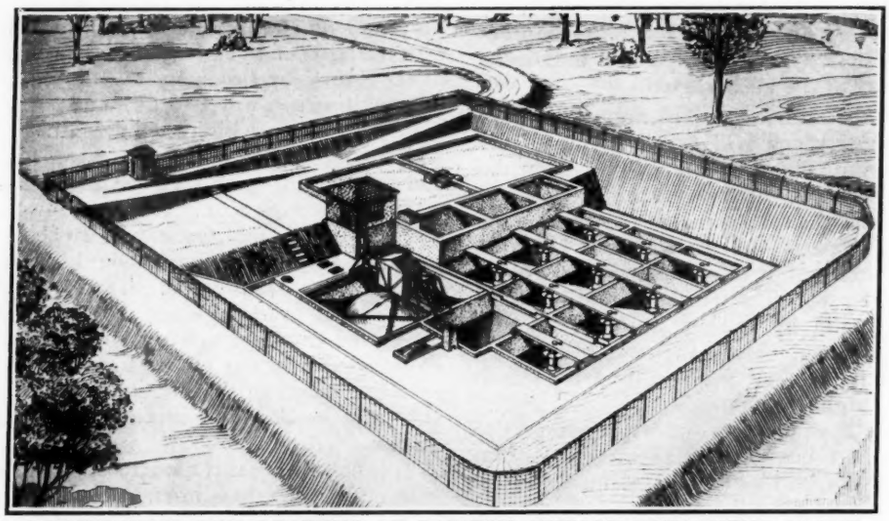
Features of design of a mechanical aeration activated sludge plant of one million gallons capacity, including sludge digestion, clarifying mechanism and chlorination

For many years the city of Lawton, Oklahoma, which has at present a population of approximately 15,000, has had serious trouble with the disposal of its sanitary sewage. In 1914 the city built an open septic tank equipped with bar screens and chain bucket pumps for removing the sludge or settled sewage. Apparently the plant worked fairly well for about two years, but as the city's population increased, and possibly through neglect, the plant did not function and for many years the sewage was emptied into Cache creek practically in a raw condition. Damage suits against the city had been filed over a period of years and the problem became so serious that Mayor C. S. Powell and the city council felt it necessary to take some action to provide for proper treatment. The Benham Engineering Co., consulting engineers of Oklahoma City, was employed to prepare plans and to supervise the construction, and bonds were voted in 1928 for a complete purification plant. A contract for the construction was awarded in October, 1928, to Earl W. Baker & Co., of Oklahoma City.

The engineers considered several types of plants, including Imhoff tanks and trickling filters which had originally been proposed by the city engineer, but it was finally decided to use the activated sludge mechanical surface aeration type of plant. Comparison of estimates of cost showed that such a plant could be constructed for considerably less money than others and it was believed that it would be more efficient and flexible. It was estimated that the construction cost of an activated sludge plant of this type would be $74,500, while that of an Imhoff tank-sprinkling filter plant would be $125,000. Also that the yearly power cost of the activated sludge plant would be $1,520 and that of pumping for the Imhoff tank-sprinkling filter plant would be $810. Capitalizing the yearly power cost at 5% gives a total capital cost of $104,900 for the activated sludge plant and $141,700 for the Imhoff tank-sprinkling filter plant. It was assumed that the cost of maintaining both types of plant would be the same.

Col. Benham believed that for the conditions existing at Lawton, the commonly designed Imhoff tank with trickling or intermittent filters or contact beds would not offer that flexibility of operation which is so necessary for a municipal sewage purification plant, where fluctuations of flow make it difficult or impossible to design a plant capable of handling such variable quantities of sewage except at heavy first cost and at a high cost of operation. Also, with the activated sludge mechanical aeration type, a plant can be built closer to the surface of the ground, as very little fall is needed through the plant.

The old disposal plant was located southeast of the city approximately three-quarters of a mile west of Cache creek (which flows east of the city), into which the effluent was discharged through a 15-inch sewer. The north portion of the city emptied its raw sewage into the creek through a 12-inch outfall line without any attempt at purification, and this, coupled with the unsatisfactory effluent from the old septic tank, made it mandatory on the part of the city to do something to treat all its sewage before emptying it into the creek, which normally has a flow of clear water fed by run-off from the Wichita mountains.



PERSPECTIVE PEN DRAWING OF LAWTON SEWAGE TREATMENT PLANT

In order to serve the north portion of the city and carry the sewage of the entire city to one point, it was necessary to construct a 12-inch outfall line from the north, and to connect this with the 15-inch outfall

*Condensed from a paper read at the Fifth Oklahoma Water Works Short Course at Stillwater, Oklahoma, by Col. Webster L. Benham, president of the Benham Engineering Company, consulting engineers, Oklahoma City, Oklahoma.

sewer from the location of the old sewage disposal plant, and an 18-inch line approximately one-half mile long from this junction to the location of the new plant. This location was, after surveying the entire situation, fixed at a point approximately one mile southeast of the city. It was found that pumping in one form or other would be necessary no matter what type of plant was selected.

The plant consists of a gate house, stationary bar screen, small incinerator, preliminary settling tank, ten aeration tanks, final settling basin equipped with Dorr clarifying revolving mechanism, sludge digestion tank, pump house, sludge drying beds, and chlorination contact chamber, together with all influent and effluent line drains.

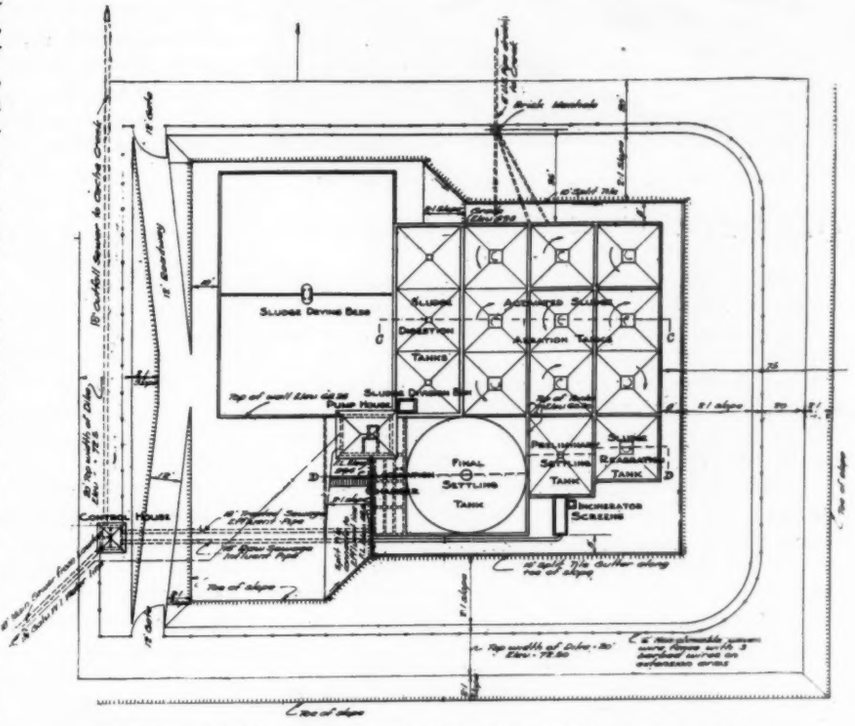
Construction throughout is of heavy-type reinforced concrete, except that the upper portion of the gate and pump houses are of brick on concrete foundations. Inasmuch as the plant had to be placed below the level of the ground surface, which is subjected to overflow from the creek, it was necessary to provide for a dike completely surrounding the plant to protect it from high water.

The plant was designed for an average flow of one million gallons of dilute sewage per day on a basis of 15,000 population, giving 67 gallons per capita per day. Owing to the fact that few water meters are in use, this amount is larger than it should be, in addition to which investigation showed considerable ground water finding its way into the sewer system.

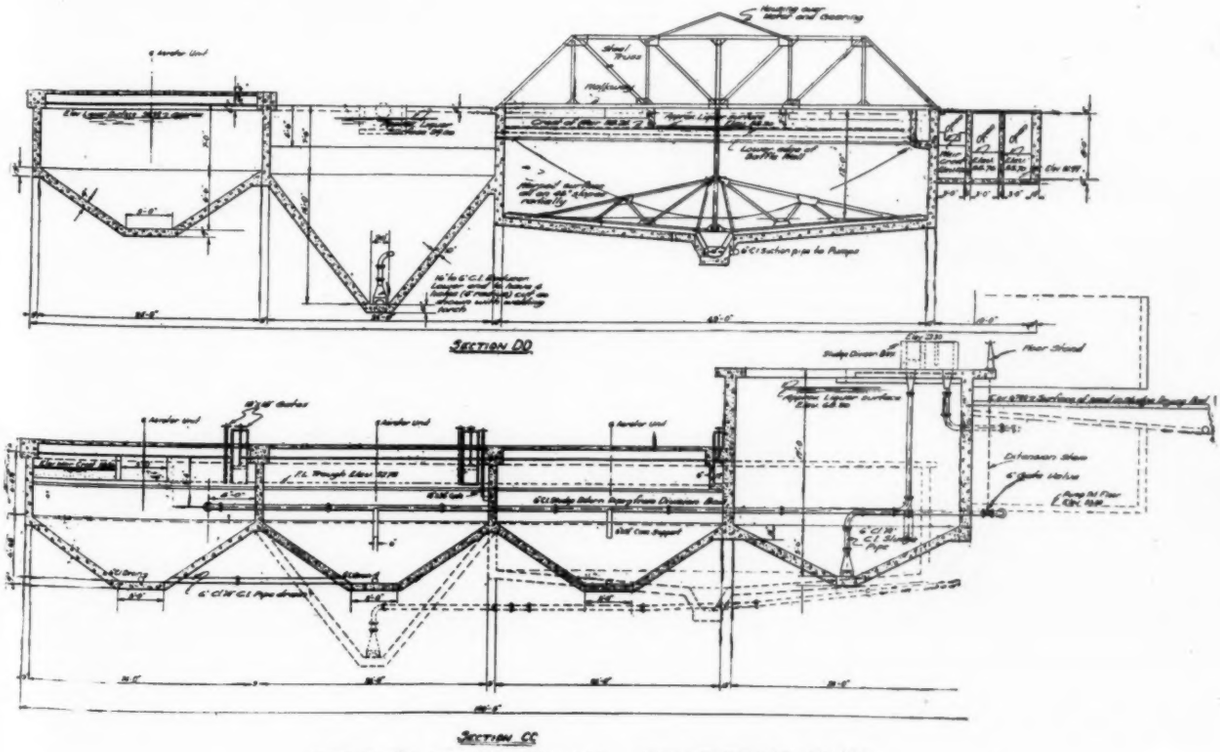
The following data were used as a basis of design of the plant:

Preliminary settling tank—1 hour retention.

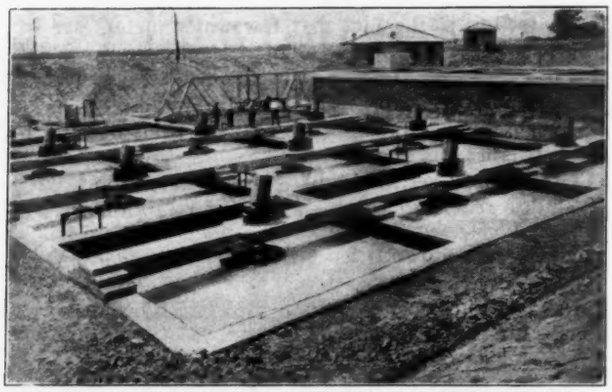
Sludge reaeration tank—4.8 hours retention (based



GENERAL PLAN OF LAWTON SEWAGE TREATMENT PLANT



SECTIONS ON CC AND DD. SEE GENERAL PLAN



AT LEFT BACKGROUND, SCREEN AND INCINERATOR. IN THE FOREGROUND, THE NINE AERATORS

on returning 90% of sludge from final settling tank at pumping rate of 140 g. p. m.).

Activated sludge aeration tanks—8 hours retention.

Final settling tank—2.5 hours retention.

Chlorination contact chamber—10 minutes retention.

Sludge removed per million gallons daily (on a dry basis), approximately 93 pounds.

Number of hours of aeration (same as retention period)—8 hours.

The capacities of the various tanks and chambers, in cubic feet per capita, are as follows:

Preliminary settling tank 0.93; aeration tanks 5.40; sludge reaeration 0.60; final settling tank 2.30; sludge digestion tanks 3.75; chlorination chamber 1.15 sludge drying bed 0.75.

The approximate daily power requirements were estimated as follows:

For aeration tanks, 1.8 h. p. per unit, or 18 h. p., equalling 13.5 kw.; which, with a daily operation of 24 hours, gives 324 kwh.

For sludge pump from preliminary settling tank 100 g. p. m. against 16-foot head for 20 minutes per day, giving 0.6 h. p. or 0.4 kw., or, for a daily operation of one-third of an hour, 0.15 kwh.

For activated sludge return pumps, 140 g. p. m. against 16-foot head, 24 hour operation at 0.8 h. p., giving 14.4 kwh.

For clarifier mechanism, assumed at 0.8 h. p., with 24 hour operation, giving 14.4 kwh.

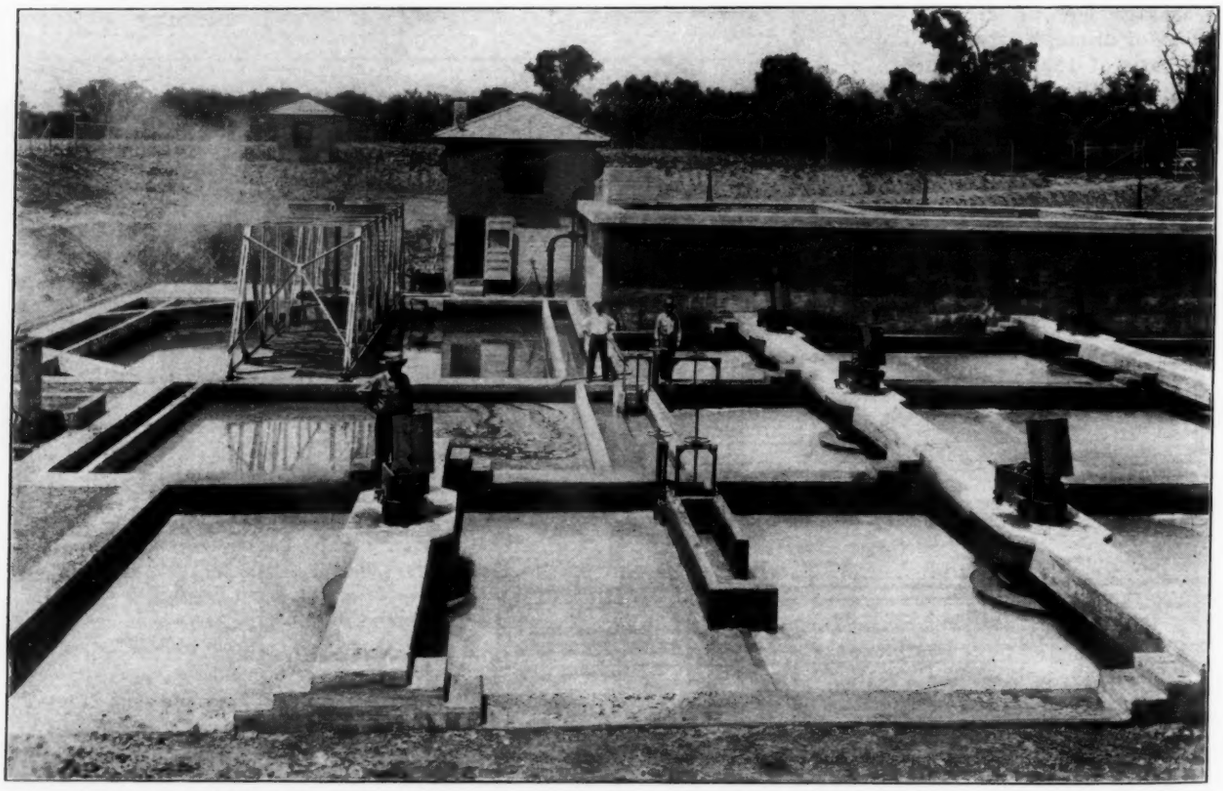
This gives a total of 352.95 or say 355 kwh. per day.

The estimated power costs, based on the demand charge of $2.00 per kw. from maximum demands of 20 kw., or $40 a month, and electric power at 1¼c per kwh., was estimated as follows:

Units Operating	Months	KW.H.D.	Total KW.H KW.H	Cost	Demand Charge	Total Cost
10	4	355	42,600	$596.	$160.	$756.
5	5	193	28,900	405.	200.	605.
0	3	31	2,800	39.	120.	159.
			Total per year			$1520.
			Cost per month			127.

OPERATION OF PLANT

The raw sewage flows into a chamber at the gate house, then to a bar screen and preliminary settling basin. The effluent from the plant also flows into the gate house and then through it into Cache creek. In the gate house an electrically operated float-control



IN THE LEFT FOREGROUND REAERATION OR SLUDGE CONDITIONING TANK. BEHIND THIS, THE PRELIMINARY SETTLING BASIN; AND BEYOND THIS, FINAL SETTLING BASIN WITH DORR CLARIFIER. AT THE FAR LEFT CORNER, CHLORINATION CHAMBER. BEYOND THE DORR TRUSS IS THE CONTROL HOUSE; AT THE RIGHT OF IT, THE PUMP HOUSE AND LABORATORY. AT THE RIGHT OF THIS, ELEVATED ABOVE THE OTHER TANKS ARE THE SLUDGE DIGESTION TANKS, AND IN FRONT OF THESE ARE THE AERATION TANKS. (FOR SOME UNACCOUNTABLE REASON, OPERATOR IN CHARGE RAISED ALL THE HOODS OVER THE AERATOR MOTORS WHEN THESE PICTURES WERE BEING TAKEN; THEY ARE KEPT CLOSED DURING USE)

motor-driven valve arrangement is provided which will automatically close the valves on the influent and effluent lines at a predetermined liquor level. Thus, either a heavy storm-water flow in the lines from the city, or back water from the creek, will operate the valves. This, however, will occur only when the outfall sewer is carrying a large amount of ground water due to heavy rains, or in the case of high water in the creek. The latter would occur only when the creek would be running bank full, and, therefore, give abundant dilution to untreated sewage when the valve on the influent line is closed. The valves can be opened again only by hand, which was thought advisable as a plant operator will be on duty all the time. The city has arranged for two operators, each working on a 12-hour shift.

The settling basin has a steep hopper bottom into which the heavier solids settle out, which bottom is connected by a suction line to a plunger sludge pump which has capacity of 100 g. p. m. against a total head of 30 feet, and is gear-driven by 5 h. p. motor. This pump is used about 20 minutes a day to remove the sludge from this tank by pumping it into the sludge digestion chamber.

The effluent from the preliminary settling basin flows through a trough to the aeration tanks, where it is mixed with a predetermined amount of sludge from the final settling tank. The sludge is pumped from the final settling tank into a division box, where the amount to be added to the digestion tank is controlled by means of a sliding gate in a division box mounted over the tank.

Each of the ten aeration tanks is provided with a Simplex revolving aerator cone, with vanes so designed that upper and lower films of liquid are thrown over the tank surface causing bubbles of air to be formed. The revolving cone also keeps the body of sewage in the aerator tank in constant circulation. The sewage is drawn up through the up-take tube from the bottom of the hopper below the aerator, causing the sewage outside of the tube to take a downward and spiral motion, thus effecting complete and thorough mixing of the activated sludge with the incoming raw sewage. (A description of the Simplex aerator as installed at Princeton, Illinois, was given in

AERATOR IN PLACE IN AERATOR HOPPER. AT THE TOP IS SEEN THE MOTOR IN THE HOUSING

AT EXTREME RIGHT, SCREEN FRAME OVER SCREEN BOX, AND SMALL INCINERATOR. LEFT OF THIS, PRELIMINARY SETTLING BASIN, AND IN FRONT OF IT, FINAL SETTLING BASIN. BUILDING IS PUMP HOUSE AND LABORATORY. AT LEFT OF THIS, ELEVATED, ARE SLUDGE DIGESTION TANKS, AND IN FRONT OF THEM, THE SLUDGE BEDS

PUBLIC WORKS for May, 1928.) Each cone is geared to revolve at approximately 60 r. p. m. and is driven by a 220 volt, 3 phase, 60 cycle, 900 r. p. m. motor equipped with starting switch with overload and low voltage release, and controlled from the pump house by push button located on a panel in the pump pit. Control gates are provided so that a maximum degree of flexibility in operation of the tanks can be produced by cutting out certain units at times when complete operation of all units is unnecessary for producing satisfactory results. Only during the summer months will it be necessary to operate all of the aerators.

From the aerator tanks the sewage flows into the final settling basin, equipped with a Dorr mechanical clarifier so that continuous removal of the settled sludge is effected. This tank is shallow and is provided with a bottom sump connected with two centrifugal pumps (one for stand-by service), which lift the settled sludge into the division box of the sludge digestion tank, where a portion of the sludge is allowed to flow by gravity to the reaeration tank while the remainder flows into the sludge digestion tank. This sludge division box is manually controlled so that accurate proportioning of the amount of sludge to be returned into the aerator tanks can be effected, this proportion being determined according to results that are obtained in the practical operation of the plant. This part of the plant is of great importance, being the controlling factor in the activated sludge treatment, eliminating all possible chance of losing previously developed activated sludge.

After a period of digestion in the sludge digestion tank, the sludge is drained off by gravity to sludge drying beds, where it is air dried, giving a rich fertilizing agent. The drains from the sludge beds are connected with the effluent line, and the effluent runs into the gate house, and thence through the outfall line to the creek.

The manufacturer of the aerators has guaranteed the operation of each aerator in that there will be no odor nuisance from the aerator tanks, and that there will be a 90% reduction in the 5-day bio-chemical oxygen demand based on a normal operation of 80,000 gallons per unit per day treating a domestic sewage having an average 5-day bio-chemical oxygen demand of 150 p. p. m. It is believed these guarantees will be exceeded.

Since the plant was put in operation, June 15th, it has developed that there is an abnormal amount of ground water, considerable grease and some creamery wastes reaching the plant. It is probable that the city will pass an ordinance requiring garages to provide satisfactory grease and oil traps.

A chlorination contact chamber was provided for sterilizing the effluent from the final settling basin, largely as a matter of precaution and to overcome the prejudice of the public.

The cost of the complete plant and outfall sewer was approximately $115,000.

Sanitary Engineering Courses in the United States

A compilation of data concerning sanitary engineering courses in the colleges of the United States has recently been prepared by the United States Public Health Service. From this summary it appears that there are 16 colleges in the United States at present operating either regular or optional courses in sanitary engineering.

There seems to be considerable difference of opinion among the universities as to the fundamental conception of a sanitary engineering course. The sanitary engineering courses are in reality civil engineering courses with certain appended subjects, such as water supplies, sewage disposal, the bacteriology and chemistry of water and sewage, and a little public health instruction.

Emphasis in both sanitary engineering and public health subjects reflects in practically all the institutions the personality of the professor of sanitary engineering.

The number of sanitary engineering graduates annually is increasing. There is a great variation in the degrees granted by the institutions for equivalent work and also in the names of the courses. In four of the sixteen institutions, the term of the sanitary engineering courses is either five or six years.

Sewerage Improvements in Nantucket

Treatment plant, intercepting sewer, pumping plant and force main being constructed to prevent pollution of harbor

The Island of Nantucket, located in the Atlantic ocean about twenty-five miles south of Cape Cod, is known chiefly as a summer resort, the summer population approximating 15,000. The sewage of the island is discharged into Nantucket harbor through an 18-inch outfall. The tidal currents in the harbor do not prevent the sewage from reaching the bathing beaches or remove it satisfactorily from the harbor; which condition is, of course, seriously objectionable in the case of a summer resort.

The sewerage system receives a considerable amount of storm water, which the sewers were not designed in size to carry; and the topography of the island is such that the sewers have slight grades, a result of which is that during heavy rains and high tide there has been overflowing of street manholes and flooding of household fixtures.

The town last year appropriated $188,528 for remedying these defects and work on the improvements has been going on for the past year. These improvements include constructing low-level intercepting sewers which carry all the sewage to a sewage pumping station, from which it is forced through a 20-inch cast-iron force main 18,000 feet long to slow sand filter beds. This will result not only in discharging a comparatively pure effluent, but will prevent tides backing up into the sewerage system.

The intercepting sewers are of vitrified pipe from 12″ to 30″ diameter, the 30″ main discharging into a pump sump at the pumping station with its invert three feet below mean low water. At the pumping station, which is located near the harbor front, is a grit chamber, screen, pump sump, and pump room containing two electric motor-driven centrifugal pumps, each with a capacity of 1,400 gallons per minute, and a venturi meter. The pump room floor is 18½ feet below the ground surface and 10 feet below mean low

water. Coarse sand was encountered in the excavation, so that a six-inch and two four-inch centrifugal pumps with a combined capacity of 2,000 gallons per minute were required to keep the water down during construction. Although this water was drawn down to a level 16 or 18 feet below mean high tide, at a point within 500 feet of the harbor, it was free from any salty taste.

The force main is constructed of De Lavaud centrifugally cast pipe in 12-foot lengths, with joints made of Leadite. The pipe was furnished by the U. S. Cast Iron Pipe & Foundry Company at Birmingham, Alabama, shipped by rail to Norfolk, Va., where it was loaded on barges and delivered by them directly to Nantucket. Here it was unloaded by the ship's derrick directly on to trucks which hauled it 1¼ miles to a temporary storage. From here it is hauled and distributed along the line of the force main as needed. The force main was installed directly by the town and the pipe hauled by the town truck equipped with a derrick operated by the gas engine of the truck.

In making the joints, one strand of ½ inch braided jute was used for yarning and the usual pouring gate used in pouring the Leadite. The average amount of Leadite used in the joints was 11½ pounds.

The excavation for the pipe was done by hand, there being no trenching machine on the island and the cost of purchasing or renting one and transporting it from the mainland did not seem to warrant it. (Incidentally, it is only a very few years that automobiles have been allowed upon the island.) About 13,000 feet of the force main was laid across the open country where the soil was sandy and caved badly, but as the depth of the trench was only about four to four and a half feet, it was allowed to cave in, as rehandling the earth seemed less expensive than the cost of sheathing the trench. The average rate of progress along this part of the line was 200 feet per day with a force of 20 men. The 20-inch cast-iron pipe, class 100, was lowered into the trench by a four-leg derrick with 1-ton chain falls.

The remaining 5,000 feet of force main was through the streets of Nantucket. Here also the soil was sandy and sometimes contained considerable ground water and close sheeting and bracing were necessary throughout most of this section. Also many gas, water and sewer pipes were encountered, and this all delayed the progress of laying to approximately 60 feet per day with a force of 18 men.

The higest point in the force main is at elevation 33, which is about midway between the pumping station and filter beds. Here a manhole has been provided to allow the air to escape or enter the pipe as it is filled or emptied. There is also a summit at one other point, between this manhole and the pumping station, and here a two-inch air and vacuum valve has been installed.

The consulting engineers for the work are Weston & Sampson of Boston, Mass. The contractor for intercepting sewers in Cenedella & Co. of Milford, Mass. The force main and filter beds are being constructed by the town under the supervision of the sewer commission.

Catch Basins as Mosquito Breeders

The Des Plaines Valley Mosquito Abatement District includes an area of 76.5 square miles, containing a population of 200,000 people. During 1928 the district spent $53,455 in permanent improvements such as drainage and $53,073 in operating expenses. A total of 1717 acres were oiled at a cost of $12,674; the average amount of oil used per acre per season was 34 gallons, and the average time required to oil an acre was 8.6 hours. Of the mosquitos caught, 84.5 per cent. were marsh mosquitoes and 13.2 per cent were domestic mosquitoes which breed in polluted water.

One recognized source of domestic mosquitoes is the street catch-basin. Referring to this, the annual report of the district says:

"The number of mosquitoes bred in catch basins over a limited area never exceeds the number produced in polluted rivers, streams or large marshes. On the other hand, the number bred in catch basins often exceeds the number bred in artificial containers on home premises. However, in the catch basin, breeding is more or less constant, while home premise breeding varies both as to neighborhood and number of potential breeding places present at any one time.

"The control of catch basin breeding is very necessary in that production here may be the principal source of annoyance especially in the high class residential districts from which the District receives its best co-operation. There are 20,000 catch basins in the 30 square miles of built-up area in the district. The cost per treatment with oil or mosquito repellent for the season averaged 2½ cents per catch basin."

Difficult Soil for Shoveling

In excavating for the approach to the Detroit-Windsor tunnel being built under the Detroit river between Detroit, Michigan, and Windsor, Ontario, the Mark R. Hanna Co. of Detroit (or rather the Colwell Bros., which firm is handling the excavation for the Mark Hanna Co. on a day basis) found themselves called upon to handle an unusually sticky, gummy, blue clay, some of the characteristics of which may

GUMMY, BLUE CLAY IN APPROACH TO DETROIT TUNNEL

be judged from the accompanying photograph. There was not so much difficulty gettting the material into the dipper, but gettting it out of the dipper was a more difficult matter. The material does not break or crumble but sticks and stretches almost like glue, as indicated by the piece which overhangs the side of the truck in the photograph. This naturally causes delay and requires expert manipulation of the bucket in order to dislodge the clay from the bucket. In spite of this, at last reports, the shovel, a Bay City tractor shovel with special short boom for tunnel work, was said to be averaging twenty-five bucket loads per hour, and was operating continuously 22 hours per day in two 11-hour shifts. The cut is being excavated a little over 13 feet wide and from 40 to 95 feet below street level.

Improvement of Taste of Chlorinated Drinking Water by Use of Activated Charcoal Filters*

By Karl Imhoff, Br. Ing., and F. Sierp, Ph. D., Ruhrverband, Essen, Germany

Chlorine is almost universally used at the present time for the disinfection of drinking water. This process has exceptional technical advantages and is unusually efficient. It has only one drawback, namely, that occasionally complaints are made concerning the taste of the water. This is especially so if the raw water contains only the minutest trace of phenols. Even if chlorine of itself and phenol of itself are not present in sufficient quantities to be detectable by taste, the two together form a chlorophenol substance which often gives the water a very strong, although harmless, taste and odor. A pure phenol solution or chlorine solution does not have a detectable taste in a dilution of one to one million. If they are mixed, however, they sometimes have a detectable taste in a dilution of one to five hundred million.

The simplest control would be the exclusion of the phenols from the raw water. This, however, is usually not possible since there are an exceptionally varied number of sources of phenol. Phenol occurs in the following: (1) coke and gas works; (2) lignite distillation plants; (3) charcoal works; (4) rain water from the grounds of factories in which tar is used; (5) rain water from tarred roads; (6) precipitation from the air (including snow) from the vicinity of coke works; (7) protective coatings on distribution mains and tanks; and (8) decomposing organic river mud.

This list of sources of phenol shows clearly that the recovery of a greater or less part of the dissolved phenol from the wastes of coke plants does not solve the problem for water works. The taste-producing materials are not produced by phenol alone, but by a large number of other chemical substances which arise from similar sources; for example, cresol, xylene, anisol, guaiacol, anthracene, naphthalene, etc.

Besides dissolved phenol, there is also the tar produced by charcoal works which, on account of its solubility in water, is exceptionally troublesome. It collects on the bottom of the stream or on the bank, and gives off its phenol content continuously, particularly when the sludge is stirred up by an increased stream velocity. In rain water that had flowed for a short time over a tarred street we have found a phenol content of 10 milligrams per liter, likewise in rain water and snow from the vicinity of a coke plant. The black digesting or digested organic sludge from a river bottom has a tarry odor. If it is stirred up in water, it gives up the same taste-producing substance.

In wells in river bottoms (infiltration galleries) we have found that chlorine can be used without the slightest danger of taste, if the natural biological conditions in the river and the underground gravel are in proper order, even though the river water contains phenol. The phenols are decomposed by the biological process under these conditions, and chlorination of the drinking water does not produce an unpleasant taste. On the contrary, one finds as a rule that the chlorination improves the taste of the drinking water. This is not the case if the biological conditions in the river or in the underground gravel are disturbed, for example, as by frost or by high water. Low temperatures may completely disorganize the biological purification. High water has a three-fold action. It stirs up the phenol-containing sludge lying on the river bottom and the bank, which would otherwise be unobjectionable, and mixes it with the water; it removes the natural filtering layer from the river bottom; and it shortens the flowing time from points of phenol pollution to the water works. In this way the phenols may enter the water intake during high water. The danger is more serious the more the self-purification is disturbed by frost at the same time.

If one considers the various sources of phenol mentioned above, it is apparent that a large number of them cannot be controlled by sewage treatment plants. Sewage treatment plants are even less important in connection with this problem when it is considered that the danger of phenol tastes is greatest at times of frost and high water, at which times many sewage treatment plants are out of operation or are operating at a diminished efficiency.

It is, then, practically impossible to handle the chlorophenol taste problem in drinking water from the sewage treatment side with complete satisfaction, and also it is desirable to employ those processes which are aimed at the removal of the chlorophenol taste from the drinking water itself. All of these processes have the advantage that the water-works itself is available and can help when a disturbance occurs, as for example, during high water and heavy frost. The installation should be capable of being bypassed during normal operation and stand ready for use in case of emergency.

Among these processes, filtration of the water through activated charcoal appears to hold an important place. Experiments with activated charcoal have previously been made in various places. Sauer describes the use of charcoal for disinfection and purification of water in German Patent, Number 400,128. Wolff* used a filter filled with activated charcoal to sterilize water in the tropics. Adler† has proposed

*Translated by A. M. Buswell, Chief of Illinois State Water Survey, and Professor of Sanitary Chemistry, University of Illinois.

*Wolff. Ueber ein Filter, das auch bei Tropentemperatur steriles Wasser liefert. Nederlandsche tijdeschr. geneesk. Dienst Jahrg. 69, 1925.

†Grassberger und Noziczka. Wiener med. Wochenschr. 1927 Nr. 35, 36, 38. "Die Entkeimung des Wassers mit Chlor und die Entfernung des Chloruberschusses nach der Entkeimung."

heavy over-chlorination with about 3 milligrams per liter, allowing a reaction time of 30 minutes, by which the organic material is oxidized. For the removal of the excess chlorine he has proposed a filter of activated charcoal. We have verified Adler's investigations and have found that one must avoid loading the charcoal filter with organic matter and other slimy material like iron or manganese. The charcoal filter may only be used for completely purified water which requires merely the removal of taste-producing material, that is, chlorophenols.

In the first experiment we used tap water to which a strong chlorophenol taste had been imparted by the addition of 1 milligram per liter of phenol and one milligram per liter of chlorine. The glass filter filled with activated charcoal of a grain size of 2 millimeters took up 1½ to 2 per cent of its weight of phenol before a taste appeared in the effluent. The filter can be regularly returned to its original efficiency by steaming out the phenol for a quarter of an hour. In an experiment on a larger scale with a filter of 20 liters capacity the taste first appeared in the effluent after 25 cubic meters of water had passed through the filter. This corresponds to 125 cubic meters of water purified per liter of charcoal. The filtration velocity was 6 centimeters per second.

After this investigation, the Ruhrverband arranged a plant scale experiment at one of its city water-works having a daily capacity of 25,000 cubic meters. This water-works was situated below a charcoal factory and had been troubled with tastes for many years. This water-works was equipped with an artificial sand filter. It was necessary to place the charcoal filter in the pressure line following the pumps under an operating pressure of 15 atmospheres. The cross-section of the filter is 3 meters. The depth of the filter material is 2½ meters and the filter content is 20 cubic meters. The charcoal is placed between two perforated plates having openings 21 millimeters in diameter. A fine copper sieve is placed upon the lower plate and a 5 centimeter charcoal layer composed of 4 millimeter grains is placed upon it, then a second layer of 5 centimeters depth composed of 3 millimeter grains. In the upper portion the grain size of the charcoal is 2 millimeters. The charcoal is held in place by the pressure of the upper perforated plate. The water flows upward through the filter. The air trapped beneath the filter is let out. The steaming out of the charcoal (which up to the present time has not been necessary) is to be done from the top downward, that is, in an opposite direction to the water flow. For this purpose a steam line is connected to the dome of the filter.

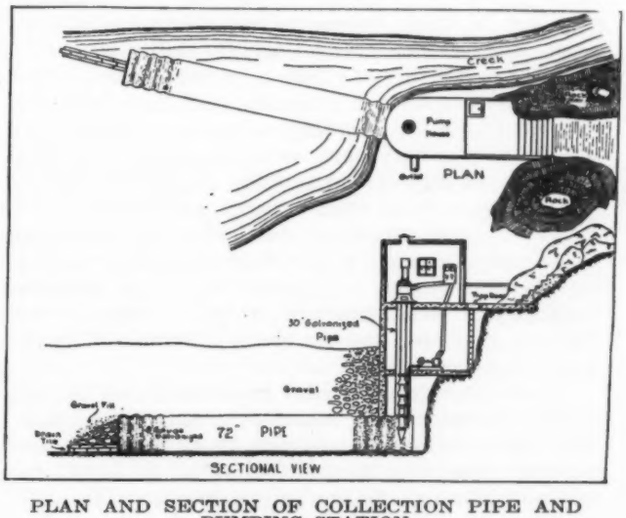
The filter operates under a loss of a head of about meters of water. The cost for a daily capacity of 25,000 meters amounted to about 20,000 marks, of which half was for the charcoal. The filter has been in operation for several months with good results. While the raw water has had the customary earthy, musty odor, the filtered water tastes as fresh as spring water. Apparently in addition to the chlorophenols, all other unpleasant taste-producing materials—such, for example, as those which come from algae and mineral constituents,—have been removed.

Further results on the operation of this filter are to be reported later. The possibility of recovering phenols from phenol works is also to be further investigated.

Utilizing Creek Underflow at Prescott, Arizona

Prescott, Arizona, has a population of about 8,000; which population, although not large, the water department has found some difficulty in providing water for. The rainfall in that section of the state averages between 15 and 20 inches a year, but some years there is practically no fall of either rain or snow on the mountains surrounding Prescott on three sides. Granite creek, which carries toward the north the runoff from these surrounding mountains, has a watershed which all lies within six miles of the city. A storage dam south of the town impounds sufficient water for a seven months' supply, which is ample during the years of normal rainfall, but when there is practically no precipitation for a year the reservoir is entirely emptied.

For several years the city experimented with cut-off walls, diversion dams, tunnels, side infiltration galleries, and wells as a means of using the under-surface flow of Granite creek as an emergency supply. Finally in 1928 a method was devised and put into operation which apparently is working out successfully. At a point where the creek is narrowed by rock outcrops, the gravel was stripped to bedrock with a dragline and the high points were blasted off, leaving a level section across the creek. In this was laid fifty feet of 72-inch corrugated pipe, perforated with half-inch holes on five-inch centers in each valley of the corrugation, giving a total of about 8 square feet of opening. The pipe was "Armco" special collection pipe made of 8 gauge galvanized corrugated ingot iron. This pipe was laid with one end close to one bank, and a pumping station was built over this end, which was bulkheaded. The other end, in the center of the creek, also was bulkheaded, and three lines of 6-inch drain tile were continued from this across the creek. The backfill over both the collecting pipe and the tile was made with two feet depth of graded broken rock, on top of which was placed sand and gravel up to the level of the creek bed. At the shore end of this pipe was fitted a vertical length of 30-inch galvanized corrugated pipe to serve as a pump well.



PLAN AND SECTION OF COLLECTION PIPE AND PUMPING STATION

On the upper floor of the pumping station, about 18 feet above the collection pipe, is a vertical 100 h. p. motor connected to a 600 g. p. m. centrifugal pump; while on the lower floor, about 10 feet lower, is a multiple centrifugal pump of 300 g. p. m. capacity direct connected to a horizontal motor. Both are operated from the same automatic starter and float switch.

The collection pipe can be entered from the pump house by means of a ladder, this being done during low water when the pumps are able to hold the water down in the collection pipe. This permits an inspection of the pipe, removing any sand which may collect there, etc., and was the chief reason for selecting a collection pipe instead of a cutoff wall.

After the first month of pumping, the well was cleaned of sand and since then no sand apparently has come through the gravel bed into the pipe. During a recent dry spell when this source of supply was used, the pumps ran approximately two hours and were off one hour out of each three. While this service was continuing, a flood four feet deep came down the creek running muddy water from bank to bank. Investigation showed that the pump was still running clear water and operating two hours out of the three, showing that the quality of the water was not immediately affected by flood, and therefore that the water apparently filtered through a considerable length of the channel above the pump house and was thus cleared of the mud carried by it before it reached the collection pipe.

Subterranean Water Supply Problems

Determination of extent and available yield of each water-bearing formation precedent to allocation of supply.

In a paper before the Institution of Civil Engineers entitled "Some Problems in Engineering Geology," Edgar Morton discussed, among other phases of the subject, that of subterranean water supply. England is finding itself to be approaching the limit of its surface supplies and the number of wells sunk by public authorities is increasing. "The time must arrive," said Mr. Morton, "when the question of allocation of our subterranean reserves and the limits of protection which should be given to existing and future schemes will have to be seriously tackled." This is a problem which is beginning to arise in certain sections of this country; but, as in England, "The first step is to determine as accurately as possible the extent of our various water-bearing formations.

"Those areas which are occupied by geological formations belonging to the Secondary and Tertiary periods are entirely dependent upon subterranean supplies, and such formations occupy the whole of the Eastern, Midland and Southern Counties of England.

"A section across England from the Welsh borders to the Thames estuary serves to reveal the relationship between the various water-bearing and non-water-bearing formations. Generally speaking, the various formations dip under one another to the east, or southeast, and the different water-bearing formations are separated from one another by impervious clay or shale formations. In consequence of this easterly tilting of the strata, each water-bearing formation consists of an exposed area where the rain water penetrates directly into it, and a subterranean extension lying concealed beneath other formations, and which, therefore depends for its supply on rain water percolating into the exposed outcrop and passing underground along the dip.

"When a porous formation passes underground, its subterranean extension may be considerable or very limited, while its thickness may vary. Furthermore, structural features such as folds and faults, which are not apparent at the surface, may interfere with or utterly destroy the freedom of circulation of water in the subterranean beds.

"It was with a view to determining as far as practicable from existing data—the records of boreholes and wells — the subterranean extent, depth below the surface, variation in thickness, and general form of the various water-bearing formations in England that the writer undertook investigations some years ago; the ultimate object of his inquiries was the production of a series of maps for each water-bearing formation, which would reveal these features, and serve as a basis for ultimate estimation, and allocation, of the underground water reserves of the country.

"Before any attempt can be made to allocate definite areas to specific authorities or uses, or effectively to fix protective zones, it would be necessary to know, within reasonable limits of accuracy, the available yield of such areas. Similarly, any authority desirous of promoting a scheme, requires to obtain beforehand some idea of the probable yield of a proposed borehole or well.

"The total amount of subterranean water abstracted by pumping from an area, must not exceed that proportion of the rainfall which is percolating into the area, otherwise the permanent 'natural' storage reservoir would be gradually depleted.

"Several authorities have experimentally endeavoured to ascertain, by means of suitably constructed gauges, the amount of percolation into various types of soils, subsoils and rocks. Valuable as the results of these experiments are under specified conditions, their application to wide areas, such as are concerned in water supply schemes, is limited and liable to be misleading.

"The whole problem of percolation is so complicated by variations in topographical, meteorological, geographical and geological conditions, that it must be approached from an entirely different direction as explained below.

"With regard to the yield of wells and boreholes, various formulae have been deduced from mathematical theories of interstitial flow, based on the assumption of a homogeneous rock texture, which is rarely realised in practice.

"Geological formations are notoriously variable in texture and structure when traced laterally from place to place, and vertically from the surface downwards. The nature and amount of cement in the interstices varies; the shape of the grains and their degree of interlocking varies. Both these factors affect the porosity and the rate of interstitial flow of water.

"The frequency of bedding planes, joint planes and fissures which tend to act as intercepting drains, will

affect the draw and yield of wells. In the upper parts of anticlines wide tension fissures are present, while in synclines the fissures may be closed by compression.

"Faults in certain areas may be 'closed,' or filled with impervious clayey material, which tends to arrest subterranean flow and reduce the porosity of the strata in the vicinity. Alternatively, faults may so fracture the local strata as to increase the flow in their vicinity, and cause a greater yield and draw from wells.

"In view of these variable geological factors influencing the yield and draw of wells, and the equally variable factors affecting percolation, any attempt to determine experimentally the amount of percolation or predict the yield and draw of wells in any area by the application of precise formulæ, is likely to prove negative. The problem must be tackled from a practical standpoint.

"Each water-bearing formation should be divided into convenient regions, determined preferably by subterranean watersheds, data being accumulated as to the yield, rest, pumping levels, draw of wells and boreholes under given conditions, and their influence on surface springs and streams ascertained for each region.

"Such data, considered with reference to the geological character and structure of the pervious beds, would provide a basis for estimating the water-yielding capacity of each area, and serve as a guide in awarding effective protective zones, and thus avoid the danger of interference of contiguous wells.

"A vast amount of the requisite data lies buried in the private records of waterworks authorities, and will continue to remain so under the present state of legislation. If we are to make the best use of our future reserves of subterranean water, the publication of such data in the national interests should be rendered compulsory. In the meantime, we are to continue to face unnecessarily prolonged and costly Parliamentary and Ministry of Health inquiries.

"The actual choice of the site for a well or borehole involves, firstly, a knowledge of the laws of subterranean water circulation, which varies in different types of pervious strata, and secondly, a detailed consideration of the geological structure of the area involved. Both factors are largely a question of field experience. Each area presents its own particular problems. The subject cannot be discussed in this paper."

Pumping Sand From Settling Basins

El Centro, the county seat of Imperial County, California, with a population of about 7,000, draws its water supply from the Colorado river, which is generally turbid; it is said that in one year it transports over 100,000 acre-feet of soil out of the United States into Mexico. The water from the river flows through a concrete flume to a group of eight settling basins with an aggregate area of 170,000 square feet and an average depth of 9 feet. From these settling basins it pases to sand filters.

The settling basins are cleaned by means of a 3-inch sand pump mounted on a car travelling on an industrial track system on the banks of the basins. At one side of each basin is a sump and above this an overhead steel frame from which the sand pump, car and all, can be lowered by means of chain blocks to the bottom of the reservoir to reduce the suction lift. The water in the basin having been drawn down, the sediment flows to the sump, whence it is pumped out. As the bottom is on a very flat grade, the flow of the sediment is aided by a jet of water from a hose nozzle supplied by a 3-inch jetting pump. The sand is pumped through a pipe to settling ponds, where it is air dried. When dry, the sand is used for raising the embankment around the ponds and filling the land surrounding them. This sediment now covers several acres to a depth of 20 feet or more and additional land has been purchased recently to provide room for future operations.

Other cities in Imperial valley dispose of their silt in a similar manner, but at Calexico and Brawley the sediment is sluiced by gravity to the New River channel, a gorge from 1000 to 1500 feet wide and from 50 to 70 feet deep which was cut out by the Colorado river at the time it was flowing into the Salton Sea.

Cement Joints for Water Pipes

Although cement was used for joining cast-iron water pipe forty odd years ago, by San Jose and Redlands, Calif., and later by Los Angeles, it was not until 1911 that it came into common use in that part of the country. About that time Long Beach and Los Angeles used it more or less extensively, and Portland, Oregon, in 1916 and San Francisco in 1917. The experiences of the last named city were described by O. G. Goldman, assistant superintendent of the City Distributing Department, Spring Valley Water Co., in a paper before the American Water Works Association.

He stated that cement joints have been used in San Francisco for twelve years under an average pressure of about 50 pounds with a maximum pressure of 150 pounds, and have proved entirely satisfactory. "They have stood settlement, vibration, and shock as well as lead joints in the system. When necessary, cement joints can be chipped out, using a long chisel. An 8-inch joint can be cut out in twenty minutes. One day is usually allowed for the cement to set," although in some cases water has been turned into the mains when the cement has been in place only about fifteen hours.

In making cement joints in San Francisco, the calker is equipped with a pail of water, a part of a sack of cement, yarn, a flat pan about 12 by 18 inches, a small trowel, a yarning iron, set of calking tools, and a pair of cotton gloves. The calking irons are the same as for lead except that one extra tool, more like a yarning iron than a calking tool, is added, to be used in ramming the cement into the joint, the point of this tool being 6 inches long, one inch wide and ¼ inch thick. After the joint has been yarned, enough cement for one joint is put into the pan and spread out and sprinkled with water, using a piece of yarn, then thoroughly mixed with the trowel. Its consistency should be such that it will mold, and be just dry enough to crumble when dropped a distance of 12 inches. A handful of the mixed cement is held in a gloved hand against the joint opening, while with a calking tool in the other hand the calker forces the cement into the opening, moving the hand around the joint, until the opening is filled to about half its depth. The cement is then calked into the joint as hard as possible and the joint filled again and calked.

until the cement is about level with the face of the bell. No bead is put around the outside. A man can make sixteen 8-inch joints a day and other sizes in proportion. The amount of cement used, including ordinary loss, is about one pound per inch diameter of the pipe.

Besides their low cost, cement joints aid in insulating mains against electrolysis. This is not an important factor in cast-iron pipe, but cement is used in steel mains for this purpose, where three sets of cement joints, separated from three to four feet, afford complete insulation. In the steel mains the joints are made by using steel bands 12 inches wide and 1 inch larger than the outside diameter of the pipe. The end of each pipe is inserted into the band four inches, leaving the pipes separated by four inches, which is temporarily filled by a wooden form. The annular space between the pipe and the band is then filled with pure cement hammered into place against this wooden form, which is then removed. Such a joint, however, should not be used on steel mains where there is any amount of surging or water hammer, as under such conditions the joint is soon destroyed, the cement ring being rigid compared with the steel mains and cracking badly after the first surge or two.

Leakage in Cast Iron Pipe

The subject of leakage from cast iron water pipe is becoming increasingly important as the demand for water increases and the supply decreases, and as the cost of water delivered into the mains also increases due to the necessity for going greater distances for it and also for purifying it. It is generally admitted that it is practically impossible to secure absolute freedom from leakage in a water distribution system, but it is important to determine how much of such leakage there is and what is a practicable minimum to which it should be reduced.

The last phase of the subject was discussed by Charles C. Hopkins of Rochester, New York, before the New York Section of the American Water Works Association. Mr. Hopkins tabulates data from 45 tests, 12 of them made at Hartford, Conn., 8 by the Metropolitan Water Works, Massachusetts, 14 at Akron, Ohio, and the remainder at several different cities. In the cases of the 12 Hartford tests, two tests at Columbus, Ohio, and 8 of the tests at Akron, an allowable rate of leakage was specified in the construction contracts. In gallons per inch-mile per day, these limits were 230 in Hartford, 528 in Columbus, and 200 in Akron. The measured leakage varied from 0.31 at Grand View Heights, Ohio, and 0.97 at Hartford, to 950 and 627 in two tests by the Metropolitan Water Works. In only two cases did the measured leakage exceed the allowed leakage, these being 298 and 231 gallons in Hartford, the allowed leakage in each case being 230. Most of the tests made in cities where there was no allowable leakage specified considerably exceeded 230, from which Mr. Hopkins argued that the figures from these tests favor specifying a leakage below which a piping system would be satisfactory.

Inspection of the table showed that results were obtained of less than 100 gallons per inch-mile on 42-inch and 20-inch lines at Hartford, a 20-inch line of the Metropolitan Water Works, an 18-inch line at Corpus Christi, and 4-inch to 30-inch lines at Akron; and others, totalling 54 miles of pipe of different sizes and under pressures up to 150 pounds per square inch. From this he concluded that it is practicable to insist on a maximum allowable leakage of 100 gallons per inch-mile per day.

"Specifications for pipe lines should provide for damages for exceeding allowable leakages, and also give the contractor performing the work a bonus for leakage less than the allowable. All leaks, the locations of which are known, should be corrected before testing the pipe. The damage clause should not become operative until the contractor has reduced the leakage below an amount stated in the specification, to which amount the contractor should be required to reduce it. It is also well to specify that the leakage from no one section of a system of pipe should exceed a fixed multiple of the average on the entire system.

"In conclusion, the writer is of the opinion that for pressures not exceeding about 65 pounds (equivalent to 150 feet head) and for pipe sizes of ten-inch and under, an allowance for leakage of not to exceed 65 gallons per inch-mile per day should be easily obtained; and that for sizes greater than 10-inch, the above allowable leakage should be increased somewhat, but not to exceed 25% unless there are extraordinary conditions that might affect the quality of the workmanship. For pressures exceeding 65 pounds, the allowable leakage should be increased on all sizes to something less than the ratio of the square root of the head. The writer suggests the cube root of the head or even less, inasmuch as greater care in jointing is most likely to be taken under large than small pressures. There would then be allowed on the smaller sizes for 130 pounds, or double the head or pressure, 82 gallons, and on the larger sizes, up to 102 gallons for 130 pound pressure."

Maintaining Valves and Hydrants

Methods recommended for making regular periodic inspections of these appurtenances

"Unless valves and hydrants are given regular attention and properly maintained, the water works superintendent has no assurance that they will function properly," said Carl A. Hechmer, department engineer of the Washington Suburban Sanitary District, in a paper before the American Water Works Association. He then proceeded at some length to describe what constitutes regular attention and proper maintenance.

Considering first the valves in a distribution system, he stated that these should be inspected at least once a year, preferably twice. The inspection will consist first of locating the valve box. In case it has been covered with paving material or earth, it should be raised to grade, and any stones or other materials which have found their way into the box should be removed. Whenever a box is dug up or in any other way a valve is uncovered, new packing should be installed in the packing gland.

The valve itself is to be inspected as follows: First set the valve key on the valve nut preparatory to turning the stem. Pour a small quantity of kerosene or diluted automobile crank case drainings down the

valve key stem. The oil will run down the key to the operating nut, thence to the valve stem and lubricate the valve stem against the packing gland, softening the packing. Operate the valve up and down several times, bringing the gate down into the groove hard each time, then opening the valve about one quarter way. Inability to close a valve is usually caused by the accumulation of sediment under the seat, and each time a gate is pushed down into the groove, a small portion of this sediment is pushed out, while the high velocity of the water through the partly opened valve removes what is pushed out. This operation is repeated until the groove is sufficiently cleaned to allow the gate to seat properly. If the groove is filled with large stones or with material that cannot be removed in this way, the valve must be dug up and taken apart for repairs. If the stem of the valve is found to be bent or broken, it should, of course, be repaired. In the case of geared valves, the gears should be cleaned with a wire brush and greased with a light clinging grease. The stuffing box should, of course, be examined, and the by-pass valve should receive the same attention as the smaller valves on the distribution system.

Fire hydrants should be inspected at least twice a year, spring and fall, and four inspections should be made if possible, which number is advocated by the Fire Underwriters Association. In high-value districts, weekly inspections are often made during extremely cold weather. Arrangement should be made between the water department, the fire department, and any other possible users of hydrants, to report to the water department immediately after using a hydrant during freezing weather, and an immediate inspection should be made to insure that the hydrant is left in good condition. If hydrants are used by private individuals or contractors, they should be inspected daily during freezing weather and weekly during mild weather, and a charge be made for the use to cover such inspection.

When inspecting hydrants, it is desirable to measure the static pressure, the residual pressure with one nozzle open, and the flow of water from the hydrant. Weak points in the distribution system can thus be determined and improvements due to new installations readily noted. System weakness due to unknown closed valves can also be discovered and corrected.

The following procedure is suggested for making a hydrant inspection: First, note the condition of the operating nut, the nozzle caps and chains, and the general appearance of the hydrant. Then listen for leakage with an aquaphone placed on the operating nut. Then see that the nozzle caps are on tight and open the hydrant valve. If static pressure readings are to be taken, replace one of the nozzle caps with one to which a pressure gauge is connected. While the hydrant valve is open, note if all the nozzles are tight and whether the drain valve has closed properly; if the latter is not the case, water will appear around the barrel of the hydrant outside. Then close the main hydrant valve, take off one of the nozzle caps and observe the rate of drainage of the barrel to determine whether any obstruction has entered the drain valve. If the drain valve has been obstructed, it can be cleaned by replacing the nozzle cap and opening the main valve two turns. This will allow water to enter the hydrant valve but will not quite close the drain valve, and the water escaping through this will generally push out any obstruction and cut away any stone or earth which has packed around the outside.

Then remove one nozzle cap and open the hydrant and thoroughly flush out the hydrant connection; meantime observing the residual pressure and rate of flow. Then close the hydrant slowly; if it fails to close entirely, there is probably an obstruction under the main valve. Do not put extra leverage on the hydrant wrench but open the hydrant again and then close it, repeating the operation several times without using any great force in closing, which would embed the obstruction in the main valve so that it could not be flushed out or would damage the valve seat. After the hydrant has been closed and the rate of drainage noted, the stem should be oiled and the nozzles greased with graphite grease, which will not wash off and prevents the nozzle caps from sticking.

Records of the inspections should be kept on a field sheet and from this transferred to a permanent record card in the office. There should be on file a card for each hydrant, stating the size, make of hydrant, and information regarding pressure at that hydrant. The date of each inspection should be entered on the card, together with the observed pressures and rate of flow, the necessary repairs and their cost.

Hydrants should be painted at least once every two years, and annually if possible; care being exercised to prevent getting paint on the nozzle threads or operating nuts, or excess paint in the groove on the nozzle cap which holds the chain ring.

Effect of Smoke on Rainfall*

In a paper by Dr. J. R. Ashworth, of Rochdale, read before the Royal Meteorological Society last month, some remarkable results were given in support of the theory that the rainfall of industrial areas is increased by the discharge of smoke and hot gases from factory chimneys. Dr. Ashworth based his conclusions on a scrutiny of rainfall data at Rochdale, a typical industrial centre with factories active on weekdays but with nothing doing on Sundays. He began by calculating the average rainfall on each day of the week at Rochdale for the 10 years 1918 to 1927. He found that on Sundays the average rainfall was appreciably less than for any other day of the week. The mean daily rainfall on Sundays worked out to be 13 per cent. less than the average of all days. Applying the same calculation to the rainfall data of Stonyhurst College, the corresponding difference was only 6 per cent., and, moreover, Sunday at that station was not on the average so dry as Friday. Meteorologically, Stonyhurst is situated similarly to Rochdale, but has no factories in its immediate neighborhood. The fact that Sunday in Rochdale is on the average drier than other days of the week was confirmed by analysing the returns for the 30 years 1898 to 1927, though the difference for this longer period was only six per cent. To detect the influence of factories on the rainfall of the working hours of the day as compared with the night hours, when the factories are closed, Dr. Ashworth examined the records of a rain-gauge in operation for two years at Rochdale. He took the total of all rainy intervals of not less than 15 min. duration for each hour of the

*From "Water and Water Engineering" (London) for June 20, 1929.

day for all days and worked out similar figures for Sundays only. He found that from about 7 a. m. to 6 p. m. the figures for rainfall duration on weekdays exceeded those on Sundays by an appreciable margin. During the remaining hours there were no systematic differences. Again, it was found that at Rochdale there were on the average (for all days) 14 per cent. more hours of rainfall during the day than during the night. On Sundays, however, the difference was in the opposite direction, there being 14 per cent. fewer hours of rainfall during the day than during the night. Comparing this result with similar calculations for Stonyhurst, it was seen that the average conditions at Rochdale on Sundays resembled those for all days at a station where there are no factories.

Flat-Bottom Water Tanks

In a paper before the convention of the American Water Works Association on the subject of elevated steel tanks, George T. Horton, president of the Chicago Bridge and Iron Works, gave a number of conclusions concerning design and construction of steel tanks drawn from studies made by that company covering a number of years. Referring incidentally to tanks resting upon the ground, he stated that he can see no reason for the constructing of such extensive foundations as are usually found under water works tanks; remarking that oil tanks are always built resting directly upon the ground, the only preparation being the removal of top soil and levelling of the exposed surface.

Elevated steel tanks of a size adequate for public water supplies are a development of the past forty or fifty years. At first, the tanks were made with a flat bottom; following this, hemispherical bottoms were used and a few conical bottoms, but the latter form has not found any extensive use.

When it came to building tanks of larger capacity, however, the hemispherical bottoms were found to present certain inherent difficulties. If an effort is made to limit the total height of the tank in order to prevent undesirable range of head, the diameter becomes so great that the bottom would be out of all proportion to the cylindrical part of the tank. These difficulties were obviated in part by making an ellipsoidal bottom, the vertical depth of which is but half that of the hemisphere. Tanks with such bottoms answer very well for capacities up to 500,000 gallons. Unfortunately, however, some of the stresses in an ellipsoidal bottom are compressive rather than tensile, and these in tanks of over one million gallons capacity are of sufficient magnitude to necessitate an increase in the depth of the bottom, causing an increase in the range of head and thus setting up a vicious cycle. When a limit is set to the total height of a tank, there is also a limit to the size of the tank if it be of the suspended bottom type. Where the total height of a tank is limited to 25 feet, the capacity of an ellipsoidal tank is limited to three million gallons by practical consideration, and of a hemispherical tank to 175,000 gallons.

"The suspended bottom, due to the refinement required in its construction, is the most expensive part of a tank, and as its size is increased, greater stresses necessitate heavier material." On the other hand, a flat-bottom tank requires support over a large part of the surface by means of beams and girders, which make expensive construction. It is evident that a point will be reached at which the additional material required in a suspended bottom will more than offset the cost of the beams and girders necessary to support a flat bottom.

Mr. Horton says that from studies he has made of this subject recently he can state that tanks of over one million gallon capacity may be built with flat or approximately flat bottoms which will cost less than tanks of the same capacity with suspended bottoms. He is sure that such an elevated tank with an approximately flat bottom, the height of which does not exceed 25 feet, can be built for less than can an elevated tank with a suspended bottom the total height of which will be more than 50 feet but with the same capacity and height of tower.

Control of Sewage Plant Odors

Regulation of digestion process by maintaining optimum conditions, collecting gas, cleanliness, use of chlorine and partial activation.

The subject of odors created at sewage plants and methods of controlling them or of preventing their becoming a nuisance in the neighborhood was discussed at the latest meeting of the New Jersey Sewage Works Association, the discussion being led by John R. Downes, supervising engineer of the Plainfields and Dunnellen sewage disposal works.

Mr. Downes stated that such odors naturally divide themselves into two classes—local and migrating. "Local odors are such as may emanate from exposed sewage solids about screens or where they may have been carelessly dropped by attendants, or grease cakes forming just above the water line of sedimentation tanks and baking in the hot sun. Such odors and those about small pumping stations may be annoying close at hand but certainly would not be noticeable 50 yards from the source." By migrating odors he means "odors that travel more than 100 yards, and this may stretch to a mile or two under favorable conditions. This type of odor is occasionally carried by high winds, but is then dispersed within a reasonably short distance by the very wind that carries it. Such odors become really troublesome under the peculiar atmospheric conditions which produce smoke flags. These conditions most often occur about dusk."

By smoke flags Mr. Downes referred to trails of smoke from a bonfire or other source which, under certain atmospheric conditions, hang suspended in the air a fixed distance above the ground and travel in a definite direction so slowly that the movement is not visible. Moreover, the motion is so slow that the smoke flags are not broken up by eddies or dispersed on approaching an object in their path, but they flow gently around or over such object. If they approach trees or shrubbery, they rise over the same without touching them and thus reach the far side unbroken. In the same way odor clouds are not dispersed under similar conditions by shrubbery or trees surrounding a treatment plant, but when there is wind enough to give obvious movement to the air current, the odor cloud is broken up by impingement against the shrubbery wall.

The chief offending compounds which migrate from

sewage disposal plants are hydrogen sulphide and its allies. Time is a factor in the production of such gas, the time necessary for its production in disturbing quantities being shortened as the temperature rises. Even though sewage reaches the plant in a fairly fresh condition, hydrogen sulphide in odor-producing volumes may develop in the settling tanks when these are larger than the minimum required for sedimentation and therefore retain the sewage for a long time.

"Uncontrolled digestion of sludge with exposed surface is a prolific source of odors. However, with our present knowledge of optimum digestive conditions, there is little excuse for odors from this source. The floating covers used at the Plainfield plant (see PUBLIC WORKS for August, 1928) effectively eliminate odors from this source by (a) preventing exposure to the atmosphere; (b) keeping all floating material submerged, in which case certain odoriferous compounds, otherwise formed, are not produced; and (c) providing a perfectly safe means of collecting the gas generated, thus making it available for heating the digesting sludge to the optimum temperature." In the discussion, Dr. Rudolfs stated that liquefaction is a much more odoriferous process than is gasification.

For controlling the odors, Mr. Downes stated that cleanliness and use of a good deodorant such as phinotas will overcome local odor difficulty, but a deodorant should be chosen the odor of which is not itself worse than the honest ammoniacal odor of the sewage.

The hydrogen sulphide migrating odor, when combined with chlorine gas forms a substitution product with odor varying from that of chloroform to zero, according to the quantity of chlorine used. It has apparently been shown by Lynn Enslow and William J. O'Connell, Jr., that the peak of hydrogen sulphide production almost always coincides with the afternoon peak of sewage flow, and it is necessary to apply the chlorine only to this peak, and possibly during the early evening hours when there is still some of the offensive gas being carried over from the settling tank. Chlorine is used at the Plainfield plant at the rate of 400 lbs. per day, but is applied only during four or five hours of the day, with a total daily consumption of about 70 pounds. When Plainfield is paying 6c per pound for chlorine, it costs about $700 a year for controlling the odor during the six summer months. It is not necessary to treat during the other six months because the hydrogen sulphide is not produced in troublesome quantities during cold weather.

Another method of odor control is that of partial activation. Treating 25% of the settling tank effluent by the activated sludge process and then mixing this treated portion with the other 75% of the tank effluent, very effectively destroys the hydrogen sulphide odor. "In fact, the odor, if it can be called such, is the fresh, cool odor of water trickling over mossy rocks and is rather pleasant than otherwise." Mr. Downes also stated that there is no doubt that activated sludge does a more thorough job of odor elimination than does chlorine. However, he considered that, even though it is possible to secure power free by making use of the gas from the digestion tank, the carrying charges on the machinery installation for the activated sludge process are greater than the cost of chlorine plus the carrying charges on the chlorine feeding apparatus.

On the other hand, F. M. Veatch (of Black & Veatch, Kansas City Mo.) stated that in the west they "favor activated sludge over chlorination as a means of eliminating odors where isolation is impossible. Chlorine has been very successful at Independence and at Emporia. However, our conclusion is that where power can be had as reasonable as 2c per k. w. h., activated sludge is preferable and the cost for capitalization and operation not greater than with chlorine."

Sewage Treatment at Salinas

Plans have recently been completed for improving the sewerage system and for sewage treatment at Salinas, California, one of the most interesting features of which is the complete segregation of trade waste and domestic sewage and separate treatment of the two. The city, in the spring of 1928, voted a bond issue of $350,000 for this purpose. The population of the city has increased from about 4,000 in 1920 to about 8,000 at present, and the plans, prepared by the Burns-McDonnell-Smith Engineering Co., are designed for an anticipated population of 12,500 in 1940.

The industrial sewage of the city originates from a large milk condensory and a fruit and vegetable cannery, which have been discharging their effluents in a raw state into a drainage canal which flows through the city. These wastes have an oxygen demand equivalent to the domestic sewage from a population of 25,000, or more than three times the present population. The cost of a plant for adequately treating domestic sewage if combined with this amount of trade waste would be prohibitive, and the latter is to be treated separately. It will receive pre-treatment in a small plain sedimentation tank, the effluent from which will be pumped through a short force main to a storm sewer, which is to be constructed to serve the southern section of the city. This sewer passes through the plant for treating the domestic sewage, and discharges the partially treated trade waste on to natural sand beds at the Salinas river, through which beds it will pass before entering the stream. If the industrial development of the city during the next few years should be such that the sand beds at the river will no longer be adequate to treat the waste satisfactorily, it may be diverted from the storm sewer to the domestic sewage treatment plant and given secondary treatment there.

The industrial sewer and pre-treatment and pumping plant for trade wastes are estimated to cost $16,520, and the storm sewer extensions and a sewer to conduct the trade wastes and storm water from the recently developed southern section of the city to the river, are estimated at $138,636.

The domestic sewage will be conducted through a new outfall sewer to a pumping and treatment plant half way between the city and the river, where it will receive primary treatment of plain sedimentation and separate sludge digestion, followed by secondary treatment by the activated sludge process. During the several months of high flow in the Salinas river it will not be necessary for all of the sewage to receive secondary treatment, and the plant is so designed that during such periods only a portion of the sewage will receive this treatment, thereby making possible a considerable saving in operating costs. This was also one of the

reasons for selecting the activated sludge process instead of trickling filters, since the low first cost will result in a marked saving in interest and capital charges. Another reason for selecting this process is that it is more suitable for treating strong industrial wastes, should it become necessary in the future, as stated above, to provide secondary treatment for such wastes. The sewage pumping and treatment plant for the domestic sewage and the effluent line from this to the river are estimated to cost $123,050.

Construction work on the system will be under the supervision of Howard F. Cozzens, city engineer of Salinas.

Sewer House Connections

Who designates the kind of sewer pipe used from the main sewer in the street to the building and who pays the cost of such connections? were questions asked of all of the cities in New York state a few weeks ago by William P. Capes, secretary of the Conference of Mayors and Other City Officials of the State of New York. Through the courtesy of Mr. Capes we have been furnished with the replies, which are summarized as follows:

Of the 48 cities and 28 villages replying, only four stated that the owners designate the kind of pipe to be used for the house connections. Thirty-three replied that the city or village or the city council or village board decided; and one that the city decided the kind used from the main to the curb, and the owner from the curb to the house.

The city engineer or the commissioner or board of public works decides in 12 cases; the building department, the sewer bureau or board or an inspector of one of the city departments decides in 10 cases; while in one case the city engineer decides from the street to the curb and the owner from curb to building. In 2 cases the bureau or board of health decides, and in a third case this bureau decides from the curb to the building, while the board of public works decides from the main to the curb. A board of plumbers decides in 4 cases, and in 6 cases the ordinance or sanitary code of the city regulates this. One city reports that vitrified pipe is always used and in another its method was not designated.

Of the 76 cities and villages, 70 require the owner to pay for all of the house connections from the main sewer complete to the building, while in the remaining two cities and four villages the owner pays only from the curb line to the building.

Mosquitoes Thrive in Sewage Effluent

The presence of sewage effluent in a body of water tends to stimulate the breeding of mosquitoes, according to John Peterson, superintendent of the Bergen County, N. J., Mosquito Commission. In a paper before the 14th annual meeting of the New Jersey Sewage Works Association, Mr. Peterson called attention to this, with a view presumably to securing from the operators of the sewage treatment plants aid in the work of the mosquito commission. The commission has drained swamps, ditched and diked the salt marshes, and oiled city dumps, and Mr. Peterson said that they had reached the point in the drainage program where they should be getting good results from their labors, only to find that streams and ponds which they thought pure and wholesome are actually breeding large numbers of mosquitoes, and in every such case they found that such water was receiving effluent from a disposal plant. They also found that some streams flowing through swampy lands had accumulated 6 to 8 inches of silt in the bed, which raised the flow line of the stream and caused overflowing of the adjacent swampy lands, and the polluted water settling in pools and stagnating there has created ideal breeding places for the Culex Pipien.

In one case the outlet for a sprinkling filter plant is a drainage ditch 2½ miles long with no dry-season flow. The plant is discharging an effluent which is cloudy and holds large amounts of solids in suspension, and in twelve months 18 inches of solids were deposited in the bottom of the drainage ditch. As a consequence, large areas heretofore dry were flooded with polluted water which bred mosquitoes for five surrounding communities.

In another case, a plant constructed in 1916 became overtaxed by 1926 and heavy material was discharged from the drying beds directly to the open meadow and by 1928 some three or four acres of meadow land were affected and heavy breeding was found throughout this area, which is in close proximity to several towns with a population of about 16,000. In still another case, the plant is located 1500 feet from tide water and the effluent is run from the tanks to the creek through pipes. Due to breaks in the joints of the pipes, considerable sewage is deposited over the surface of the meadows, and with each high tide it is spread in all directions through a heavy growth of cat-tails. Heavy breeding is found within a thousand feet of the pipe, but further away there is little or no breeding in the tide water that covers the meadows. This plant is near three large towns and numerous complaints have been received due to the prevalence of mosquitoes.

A survey was made of the 42 sewage treatment plants in Bergen County, and 18 were found directly responsible for mosquito breeding in waters receiving effluents from the plants, 9 were indirectly responsible, and 14 were not causing breeding.

Downtown Parking in Toledo

Parking in the business streets of cities is one of the most troublesome features in traffic control, street design and similar municipal problems. Study of this has been made in a number of cities, and among these Toledo, Ohio. The commission of Publicity and Efficiency has been making such a study, including a check of all cars parked in the business district with regard to the number and kind of parking violations, the occupation of the car owners, the point of origin of the car, the length of time the cars were parked, and the legal parking capacity of the curb in the downtown district. The study also included a study of customers' modes of transportation. The last was carried on through the cooperation of a number of down-town stores, by distributing ballots to customers upon which they were asked to indicate information pertinent to the study.

Analysis of these ballots revealed that 30.7% of all downtown shoppers come by private automobile. Of these, 14.2% park in garages and 16.5% park at the curb. Of those who park at the curb, 12.2% park inside the downtown district and only 4.3% outside such district. Of those which did not come in auto,

three-fourths said that they would have done so had they been assured of parking space, while only one-fourth would not have driven even if they had been assured of such space.

Comparing these with similar figures of other cities, it was reported that in Chicago 1.6% of the shoppers park at the curb, 11.6 in San Francisco, and 7.7 in Boston. The percentages parking in garages were 6.4 in Chicago, 6.9 in San Francisco, and 6.6 in Boston. In Chicago, 19.5 walked, 21.8 in San Francisco, and 23.7 in Boston (as compared to 10.7 in Toledo); while those coming in street cars or buses constituted 72.5% in Chicago, 60.2 in San Francisco, 62.0 in Boston and 58.6 in Toledo.

Louisiana State Highways

In seven years commission has improved six thousand miles, mostly gravel. Is now surfacing main roads. Oyster shells used in both base and surface

The Louisiana state highway commission was created in 1921 and soon began an extensive program of construction which had as its principal object the opening up of a large mileage of improved highways as quickly as possible. Gravel is abundant in this state and was used and will continue to be used for many years on those roads where it can be maintained satisfactorily and economically. At the close of the fiscal year 1928, the highway system included approximately 6000 miles of improved highways; of which 5600 miles was untreated gravel; 125 miles was untreated shell; 35 miles gravel surface treated; 27 miles macadam surface treated; 95 miles of asphaltic pavement on shell, gravel, or macadam base; 47 miles asphaltic pavement on concrete base, 53 miles of concrete pavement, and 9 miles of brick pavement.

With the construction of this mileage of improved roads, the traffic has increased, and with the adoption of an amendment to the state constitution providing for a bond issue of $30,000,000 to pave the main-traveled highways, the state is entering a second phase of highway improvement, namely, the reconstruction of the heavily traveled routes to provide for the increased traffic which demands a higher type of surfacing than gravel.

While gravel is generally found throughout most of the state, neither gravel nor stone is found in the southern portion west of the Mississippi river. Here, however, there is available a large supply of clam shells and oyster shells. This condition has affected the selection of the type of highway surfacing.

LAYING ASPHALT PAVEMENT ON SHELL BASE AT MORGAN CITY, LA.

Surveys of the gravel roads have shown that in most cases they are deficient in thickness and extensive reconstruction would be necessary before a surface treatment could be applied. Attempts to use these as a foundation for asphalt wearing surface have not always been successful. Some have failed for lack of drainage but for the most part failures were due to deficiencies in the thickness and width of the gravel surfacing. Several sections were constructed with an intermediate layer of black base, three inches thick, and these sections have developed no serious failures.

Rolled stone and shell surfaces have been utilized to some extent for foundation courses. One of the most satisfactory instances of this kind is the West End road along the Old Basin canal in New Orleans, which was an old shell and slag road which had been surface-treated several times. A levelling course of asphaltic concrete, or binder course, was used to true-up to the existing surface and this course was then covered with one inch of cold Uvalde rock asphalt. This pavement has given entire satisfaction under extremely heavy traffic.

The presence of large deposits of oyster shells on reefs on the Louisiana Gulf coast has led to the development of a new type of asphaltic mixture which promises future usefulness. In 1926 there was constructed on the Baton Rouge-Hammond highway a short section of pavement in which two mixtures of crushed shell and asphalt were used; in one of these mixtures a crusher-run shell product ranging in size from ¾ inch down to dust was used, and in the other a finer product ranging in size from 10 mesh to 200 mesh. These mixtures were laid on a gravel base and are still in good condition. In 1928 a large area of this type of pavement was laid on a shell base in Morgan City. These mixtures are made entirely of crushed shell as the aggregate, without the incorporation of sand or other fine aggregate. Cross sections of these pavements have shown that the shell particles tended to arrange themselves under the action of the roller with a flat surface parallel to the surface of the pavement. This action undoubtedly has an important effect upon the stability of the compressed mixture. If these mixtures can be placed economically they may provide satisfactory substitutes for fine-graded asphaltic concrete and sheet asphalt.

Toll Bridge Laws in California

Four toll bridge laws have been passed by the California legislature and signed by Governor Young in June, with a view to ultimately eliminating all toll charges on bridges on California highways. The provisions of these four laws are as follows:

(1) A body designated as California Toll Bridge Authority is established, and this body and the Department of Public Works are authorized by Senate Bill 700 to build, buy, or condemn toll bridges, through the medium of revenue bonds, such bonds not to constitute debts or liabilities of the state, but to be entirely retired by tolls for passage over these bridges.

(2) The authority to issue franchises for future toll roads and toll bridges is transferred by Senate Bill 701 from boards of supervisors to the State Department of Public Works;

(3) The archaic Toll Bridge Act of 1881 is repealed by Senate Bill 702. Under the act of 1881 the

State Engineer was required to pass solely on draws and spans in a perfunctory fashion, but was vested with no real authority to pass on the general financial and engineering feasibility of toll bridges.

(4) The California Toll Bridge Authority and the State Department of Public Works are authorized by Senate Bill 538 to lay out, acquire and construct a bridge from San Francisco to Alameda County, the cost of which must be borne by the issuance of revenue bonds, or by voluntary contributions of cities, counties, or the city and county of San Francisco.

The Toll Bridge Authority is composed of the Governor, Lt. Governor, Director of the Department of Finance, and Chairman of the California Highway Commission. The Department of Public Works will submit its recommendations and estimates of cost as to the acquisition or construction of toll bridges to this Toll Bridge Authority, which can then authorize or refuse to authorize the issuance of revenue bonds for the purchase or construction of the bridges. These bonds will not be a general obligation of the state but are to be retired solely from the earnings of the structure against which they are issued. They are to bear interest not greater than 6% and can not be sold for less than par. When the state and the owners cannot agree upon a price for purchasing a bridge, the state is empowered to take the bridge under eminent domain proceedings.

Highway Officials Oppose Private Toll Bridges

The sentiment against private ownership of toll bridges appears to be quite general, as already referred to several times in PUBLIC WORKS. At the June meeting of the executive committee of the American Association of State Highway Officials, resolutions were adopted unanimously stating it to be the sentiment of the executive committee not to consider any applications for a United States Route number for a road which involves the crossing of a privately owned toll bridge, unless the state or a political subdivision thereof gives evidence of its intention to take over such bridge with the ultimate object of eliminating tolls.

Oiling California Highways

The California Division of Highways reports that over one thousand carloads of asphaltic road oil will be spread on the state highways this season by the maintenance department. The work to be done is of three types: dust laying, oil surface treatment, and "armor coat" wearing surface. The present plan provides for dust laying application on 1000 miles, oil surface treatment of 160 miles and "armor coat" on 300 miles of highway. This is in addition to the oiling to be done by contractors in connection with surfacing construction projects.

Light asphaltic fuel oil is used for dust laying on unsurfaced earth roads and on traffic-bound rock surfaces wherever the volume of traffic justifies the expenditure. It not only serves the comfort, convenience and safety of traffic, but has been of direct benefit to residents and owners of orchards, vineyards and other crops adjacent to the highway. The general practice is to make two applications of oil, at the rate of one-quarter gallon for each square yard of surface, during each season.

Oil surface treatment of rock-surfaced roads will be of either penetration or oil mix type, depending upon whether the metaled surface is bound or loose. Oil containing a higher percentage of asphalt than the dust layer is used for this work.

The penetration type of work is constructed in two applications of oil and screenings on the bound rock surface, after dust and loose material have been swept off. The surface is compacted and sealed by traffic.

The mix-type of surface is constructed by mixing the oil with the top layer of rock or disintegrated granite by means of harrows and graders. This is compacted by traffic, a drag being operated meantime to keep the surface smooth. Where detours are not available, the road is worked one half at a time and one-way controls established so that traffic will not have to pass over the newly tarred surface.

The "armor coat" surface will be placed on sections where the road surface is well bound, either by traffic or by previous oil surface treatment, and has been proven stable under traffic. On traffic-bound roads a penetration coat of light oil is applied before placing the heavier oil. The "armor coat" is a thin wearing surface made up of two applications of heavy asphaltic road oil and screenings. Each application of oil is screened and then rolled. This treatment is another stage in the development of the road and, while it is considered in the nature of a temporary surface, experience indicates that excellent service may be expected where the base has been stabilized. Where base failures develop later, repairs may be made with minimum loss.

Use of Cut-Back Asphalts

The nature and use of cut-back asphalts was the theme of a paper and several discussions by representatives of asphalt manufacturers and dealers at the Annual Asphalt Paving Conference, which were contributed by Herbert Spencer, engineer of Asphalt Sales Department, Standard Oil Co. of New Jersey; A. T. Hague, Asphalt Dept., Standard Oil Co. of Indiana, and others.

Mr. Spencer defined cut-back asphalt as "consisting of a semi-solid base, thinned down to the consistency desired by a means of a quick drying solvent, generally naphtha. The use of such a material," said he, "is undoubtedly a forward step and a great improvement over the slower drying road oils. The naphtha serves the combined purpose of so thinning the harder asphalt as to enable its use in a cold condition; of more readily attaching itself to the base, and finally of disappearing by volatilization, leaving the harder asphalt as a wearing coat. There are few road surfaces that do not lend themselves to treatment by means of these naphtha cut-backs, and it is through the medium of these materials that we will probably see the greatest development, especially in the clay-gravel surfaces predominating in most sections of the United States."

"The utilization of sand-gravel mixtures containing no clay or other binding material, together with asphalt, has been in progress fully fifteen years and is well typified by the Cape Cod, Massachusetts, roads and others on Long Island. . . . However, when we encounter the formations containing clay in combination with either sand or gravel, a totally different set of conditions is before us, often requiring considerable experimentation in the selection and appli-

cation of a bituminous material in order to secure the best results." The top-soil roads of North Carolina and other southern states vary somewhat from the gravel formations found in Michigan, Indiana, and other sections; but by careful selection an asphalt cut-back has been developed that converts these well-nigh impassable roads into thoroughfares capable of sustaining a traffic far in excess of that originally planned. . . . Soils containing a minimum of gravel have been treated with naptha cut-back material under the so-called mixed-in-place method, with varying degrees of success. Hardly enough is known of this method to predict just what can be looked for in future."

Any road, before treatment with a cold surface material, especially a naphtha cut-back, should be placed in a suitable condition. . . . The old idea of merely spreading a black asphaltic material over the road, covering it, and expecting miracles to result has gone by the board." The cut-back asphalts can be used successfully not only with gravel and gravel-clay mixtures, but also with water-bound macadam roads, on which they can be used to form a wearing surface which protects the stone from disintegration, and yet does not result in waves due to excess material.

Mr. Hague stated that the use of cut-back asphalt "minimizes the hazard caused by dust which so often will break a bond between an asphalt cement and the mineral aggregate. The fact that the cut-back remains fluid on the roadway for some time after application allows for the absorption of any dust which may be on the aggregate. This quality of remaining fluid after application also increases the bond on the pavement, or on aggregates which are slightly greasy or contain other foreign materials."

Illinois, Indiana, Ohio, Wisconsin, and Missouri, have adopted a high-viscosity cut-back asphalt containing only a small amount of volatile oil. This material must be handled in the distributor in a slightly heated condition, at a temperature of about 125 to 150 degrees. It is fluid enough after having been applied to the road to allow the usual manipulation, or mixing and surfacing. It has all the advantages of a cut-back asphalt for surfacing work, with the additional advantage of being extremely quick setting. The initial setting time of this material will be approximately one or two hours under ordinary conditions.

Roadside Advertising in New Mexico

Anti-sign legislation passed by the recent New Mexico legislature threatened for a time to involve the state's highway department, which was charged with enforcing the law, into a fight with sign owners.

The futility and probable waste to both parties appealed strongly to sign board owners and highway officials alike, with the result that a meeting was arranged in which both sides presented their cases. When the problem had been fully discussed, the sign board owners decided to cooperate with the highway department and immediately remove such of their signs which were in conflict with the law, while the state officials promised that the law would not be fanatically enforced but would be interpreted in a light which would do the greatest good to the traveling public.

It is claimed that this gentleman's agreement between the two parties will do more to rid the highways of unsightly and dangerous signs than an open battle. Public opinion in the southwestern state is rapidly growing against sign board advertisers.

Roadside Weeds

Weeds along roadsides by obstructing vision are a source of danger, especially at bridges and intersections. They also conceal the nature of the surface beneath, and if this should be rough, the motorist that turns onto it may have an accident.

Many weeds are noxious in character and objectionable from a health standpoint. By limiting circulation of air they also increase the concentration of dust along the traveled way.

Weeds hinder, often completely stop, surface draining and thus increase the cost of maintenance.

A neatly trimmed road is an attractive road, appealing to the tourist and appreciated by the adjoining property owner and taxpayer.

In regions where snow is a factor, the influence of weeds on the snow removal problem should be taken into consideration.

The above is the summing up by W. H. Spindler, highway engineer, of reasons why it is desirable to keep weeds down along roadsides. He states that, as a rule, highway maintenance practice commonly recognizes two methods of combating weeds—mowing them by machine or hand, and sowing or sodding and thereby crowding out weeds. He notes, however, that railway maintenance men use several other methods for destroying weeds on the road bed, including burning the green weeds with oil or some other fuel, and poisoning them with chemicals. They also use a disc harrow in some cases. (Use of oil for burning weeds by one highway department is described elsewhere in this issue.) As a rule, weed cutting is done by the highway maintenance crew; but Ohio lets the weed cutting by contract, and on most county and township roads it is more often left to farmers living along the road.

For cutting weeds, machinery is generally found cheaper than hand methods. A horse-drawn farm reaper is often used, but there is on the market a large mower drawn by a truck or small tractor, with a cutter bar 5, 6, or 7 feet long which can be raised or lowered from a straight-up to a straight-down position, making it possible to mow side and ditch slopes. There is also a small engine-driven mower which moves under its own power and can easily do the work of ten to fifteen men with scythes. Narrow ditch bottoms, irregular slopes and small areas around obstacles can not readily be cut by machinery and must ordinarily be mowed by brush hooks or scythes.

The use of machine mowing over a large percentage of the total area is frequently facilitated by more care in grading shoulders and ditches.

The best time to mow weeds is before they go to seed. To be of much benefit, mowing should be done twice a year, say in June and August. Where snow is removed from the sides of the road, a still later cutting may be necessary, and preserving a good appearance throughout the year may require more frequent cutting.

Mr. Spindler stated that few figures were available for cost of mowing, but refers to Ohio, where the mowing is done by contract and the engineer's estimate varies from $40 to $45 a mile, based on a 60-foot right of way, berms to be mowed within three inches of the ground and the remainder within six inches of the ground, with two complete mowings of the entire right of way and two separate mowings of the berms.

Seeding or sodding with grass simplifies the problem, for even if the grass be left unmowed it is not so objectionable as weeds.

Burning Roadside Vegetation

The California Highway Department has been developing methods of burning vegetation along roadsides to protect crops and property adjacent to the highways from losses due to fires originating along the right-of-way. About 750 miles of highway roadsides were scheduled for spraying and burning this season at an estimated cost of $35,000, and most of this work has already been completed.

Methods of spraying and burning roadsides were first tried out in February, using a mixture of distillate and fuel oil, and of gasoline and fuel oil. The grass was burned immediately after the application of the oil and fair results were obtained. In the meantime diesel oil had been used in the vicinity of Rio Vista, and it was found that the grass would burn readily after using this material. The diesel oil costs about 4c per gallon as against 7½c for the gasoline and fuel oil mixture, and apparently is just as effective in killing the grass. As a result of the various experiments, the following plan was adopted:

Diesel oil is spread by tank truck equipped with compressor pump and sprayed at the rate of 1-16 to 1-10 of a gallon per square yard on the five-foot strip adjacent to the fence line opposite grain, pasture or wooded areas where fire hazards exist. It was not felt necessary to spray areas adjacent to orchards or railroad right-of-way. After the spraying has been done it is left for ten days or two weeks before burning, in order to permit as much new vegetation as possible to get a start. The burning operation will then destroy the new growth and the maximum benefit will be secured. The growth remaining between the shoulder line and the cleared area is mowed or burned. The cleared area will serve as an effective fire guard.

Sale of United States Construction Machinery Abroad

Nearly fourteen million dollars worth of construction machinery and equipment of United States manufacture was sold in foreign countries last year, according to the records of the U. S. Department of Commerce. Of this, $7,754,937 was paid for excavators (including power shovels) and accessories; $1,106,198 for concrete mixers; $2,801,507 for road equipment; $820,572 for dredging machinery, and $1,276,962 for other construction equipment.

Canada was our best customer, taking $3,602,726 worth, and Russia next with $1,042,123. Cuba bought $733,577 worth, Mexico, $612,003; and the Central and South American countries contributed $3,127,787 to the total.

The above total is more than double the amount exported in 1925, about one-third of the increase being due to Canadian sales, nearly a million dollars to those to Russia, and more than a million and a half to Central and South America, whose purchases practically doubled in three years. This increase was made in spite of strong foreign competition, especially German and British, low prices, extensive credit demands and other obstacles; and American construction machinery is being successfully operated in more than 100 countries all over the globe.

Automatic Sewage Pumping

Morristown, N. J., has had experience in sewage pumping since 1909, when four pumping stations were installed at the time of the construction of the sewerage system and treatment plant. Changes were made in the nature of the pumping plant in 1919 and again in 1927. According to F. A. Hoffman, in a discussion before the New Jersey Sewage Works Association, the motor-driven centrifugal pumps installed in 1919 gave considerable trouble but those which replaced them in 1927 have worked efficiently and economically and with very little attention required.

From the experiences of this city, Mr. Hoffman believes the following requirements to be essential for a sewage pump for booster operation:

> "1st. Ability to handle unscreened sewage continuously without clogging.
>
> "2nd. A two blade enclosed impeller with all passages rounded and absolutely smooth and hydraulically balanced to operate at full load as well as at light load.
>
> "3rd. Ball or roller bearings are desirable for both motor and pump, especially if they are to operate without an attendant. Units so equipped will run for six months or more without oiling.
>
> "4th. Motors should be protected against overload and against running single phase on a multiphase circuit by a magnetic switch and some form of thermal relay. This will allow the motor to operate for a short period overloaded if necessary to pass obstructions, but will protect it against burning out.

"The cost of the magnetic switches and relays is small, the cost of rewinding a motor being several times the cost of the protection.

"High pump efficiency, stressed by many manufacturers as being the ultimate goal, is, in my opinion, of minor importance, unless the units run into the larger sizes.

Conclusion

"Automatic sewage pumping stations can be made to operate automatically, positively and economically, and without becoming a nuisance in the neighborhood, if care is used in the design, selection and installation of the equipment.

"No sewage plant is complete without at least one portable pump. My experience with the portable type has been about the same as with the stationary type, some good, many not so good. I happen to have one of the latter. In conversation with several plant operators I have found a uniformity of opinion that the mud-hog type is giving satisfactory service, and I hope this year to replace my present pump with a mud-hog."

PUBLIC WORKS

Published Monthly
at 310 East 45th St., New York, N. Y.
Western Office: Michigan-Ohio Building, Chicago

S. W. HUME, President J. T. MORRIS, Treasurer
A. PRESCOTT FOLWELL, Editor
W. A. HARDENBERGH, Associate Editor

Subscription Rates
United States and Possessions, Mexico and Cuba.. $3.00 year
All other countries ..... $4.00 year
Single copies, 35 cents each

Change of Address
Subscribers are requested to notify us promptly of change of address, giving both old and new addresses.

CONTENTS

Study of Snow Handling Methods Needed

The total annual depths of snowfall reported by the thirty-six snow removal states, and even by different parts of the same state, differ greatly. California reports one inch minimum annual fall for the southern part of the state and 783 inches as the maximum in the northern part. Delaware reports 16.7 inches as its minimum and 22.9 as its maximum.

While it may not be impossible to keep open mountain roads where 65 feet of snow falls in one season, it is evident that the methods and equipment employed must be vastly different from those found satisfactory in Delaware. Different states have necessarily developed different methods; but while some have paid little attention to the methods developed in others, a few states have copied methods found satisfactory elsewhere without sufficient regard for the different conditions. Either is of course wrong; but the former is preferable, for it will secure progress and the ultimate evolution of the best plan for each class of conditions.

The problem is a new one, but the point has been reached where officials of all the snow states should get together and compare methods and develop a science of snow handling whereby the most effective and economical method and equipment can be selected for any given condition. This includes accounting methods. Perhaps the cost per inch-mile is, as reported, fifteen times as much in one section as in another; but it is more probable that at least half the difference is due to different methods of calculating the unit costs.

Rainfall, Runoff and Evaporation

In a paper before the Institution of Water Engineers (England), J. W. Wilkinson gave figures for rainfall and runoff on the Elan Valley water shed for a period of twenty years, which showed an annual loss (difference between rainfall and runoff) of 21.17 inches; the rainfall averaging 72.56 inches. The yield was 70.8 per cent. of the rainfall, but most of the members discussing the paper were surprized and some apparently incredulous of such a low percentage of yield; one stating that the yield from the Vyrnwy was 76 per cent.

How more than pleased American water works men would be with a 70 per cent. runoff! Some figures col-

lected by the editor some years ago, averages for ten to thirty years, gave the percentage for the Cochituate river, Mass., as 44 per cent.; Sudbury river, 49.5 per cent.; Connecticut river, 56.5 per cent.; Savannah river, 49 per cent.; Tohickon creek, 60 per cent.; Owyhee river, 16.2 per cent. The climate of the British Isles presumably explains the difference. A twenty-year rainfall average of 72.56 inches is to be found in very few localities in this country, including a narrow strip along the Pacific coast of Washington and Oregon and the mountains in the southwest corner of North Carolina. A general average for the country would probably fall below 40 inches. With this rainfall and an average runoff of 45 per cent. we have a loss or evaporation of 22 inches. This, it is noticed, approximates very closely to the 21.17 inches of the English (or rather Welsh) figures above.

This seems to again illustrate a point more than once emphasized by water-works engineers—that percentage of rainfall as a manner of expressing runoff value is deceptive and illogical; that runoff is not a percentage but a difference—the difference between rainfall and evaporation; and that the latter is much more nearly constant on any watershed and uniform in any given section of the country than is either rainfall or percentage of this running off.

Sewage Treatment and Horses

The superseding of horses by automobiles may be a fortunate thing for sewage treatment plants. It is only during the past five years or so that such plants have been able to dispose of sludge, even as a gift, except for short periods in a very few cases; but each year, now, more plants report a more receptive attitude on the part of farmers and several large plants have established a regular trade for sludge made into a form of fertilizer convenient for use.

In the past, manure (chiefly horse manure) has been relied upon largely for fertilizer where humus as well as the chemical constituents were desired. Sewage sludge would seem to offer the nearest approach to this available as an alternative. And manure is decreasing. According to the U. S. Dept. of Agriculture, there were in this country on Jan. 1st, 1929, only 14,029,000 horses, as compared to 14,540,000 a year earlier; and the number of colts born last year indicates a continuance of the decrease. The decrease of 3½ percent last year was coincident with an increase of 1½ percent in population. The number of horses now is slightly smaller than it was forty years ago; since when the population has more than doubled, the grain exports greatly increased, and more and more land originally so fertile as to need no fertilizer has begun to show signs of lessening fertility.

The decrease in number of horses last year represents a decrease of at least 5,000 tons a day of manure. Based on the Milwaukee figures, a ton a day of the "Milorganite" fertilizer made from its sewage requires the sewage of seven thousand persons; and it would therefore require utilizing the sewage of 35,000,000 persons to replace one year's loss of horse manure, assuming manure and sludge fertilizer equivalent in fertilizing value.

It would seem from the above considerations that if an acceptable manure is made from sludge, it should never become a glut on the market or fall in price below that now obtainable.

Sodium Aluminate for Charleston Filters

The water supply of Charleston, S. C., is treated by sterilizing the raw water with liquid chlorine, coagulation with sulphate of alumina, sedimentation and filtration through gravity mechanical filters, and restoration of alkalinity after filtration with sodium hydroxide.

In April, 1928, the use of sodium aluminate or "alco floc" was commenced. It was found that by the use of this chemical, introduced some eight or ten minutes after the dosage of alum, a much heavier floc was obtained and one settling more quickly; and, further, the amount of residual aluminum retained in the water was reduced to less than one-tenth of a part per million, this being lower than the aluminum content of the raw water. Also, the residual color obtainable was improved and the general aesthetic condition of the water very much improved. Bacteriologically there was no change.

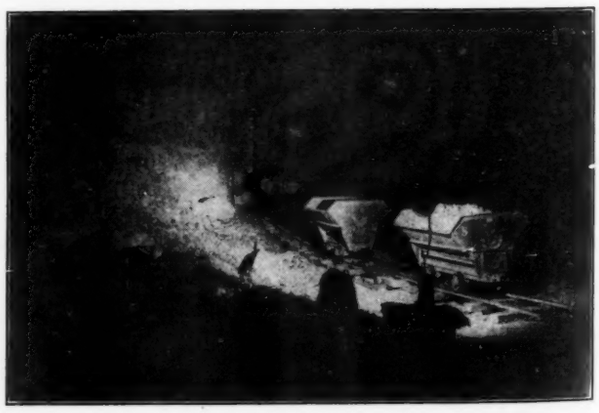
Caustic soda, or sodium hydroxide, was used to restore the alkalinity after the water had passed through the filters and before it entered the clear water basin. This treatment continued to prove advantageous over the hydrated lime treatment.

The hydrogen ion concentration or ph value of the filtered water delivered to the mains averaged 8.0 throughout the year. It was found that by the maintenance of the water at this average hydrogen ion concentration, "red water" complaints were eliminated.

A Hot Weather Suggestion

[At this writing the temperature in New York is very high and the editor is endeavoring to keep cool by removing all of the clothing which office etiquette permits; therefore the information contained below reaches him when it seems to be especially appealing.]

A large stone quarry in Texas was finding difficulty in keeping men at work due to the extreme heat during the day, and the situation finally became such as to practically necessitate suspending operation, when



LIGHTING QUARRY FACE FOR NIGHT WORK, TO AVOID WORKING IN THE INTENSE HEAT OF THE DAY

the management, in desperation, decided to try working at night instead of day. The men took to the idea readily. The quarry was not near a town of any size and there were no electric power lines within available distance, so the manager adopted acetylene flood lights, which were easily moved about. The accompanying photograph shows the illumination furnished by one of these lights. The particular lights used here were those using cakes of processed carbide called carbic and could be cared for by unskilled labor and are safe if accidently upset. They seem to have served the purpose of substituting night work for day work, which is reported to have been a great success.

Sanding Roads for Winter Safety

Ordinarily, after removing snow from a pavement by plowing the condition of the surface is not such as to cause slipping; but when it melts and freezes, or when sleet storms coat the pavement, slipping and skidding are likely to occur, to the peril of traffic, and the only remedy in such cases appears to be to coat the surface with some sort of gritty material. One automobilist informs us that during a trip from Detroit, Mich., to Rockford, Ill., in the middle of last January, he counted 117 wrecked automobiles, most of them on perfectly level and straight roads, while traces were obvious where a dozen more had been in the ditch. In cities, as well as on country roads, there is danger from the slippery pavements; not only the danger of collision with other automobiles, but skidding when compelled to stop quickly by the sudden flashing of a traffic stop light.

In many cities and on many country roads it has been the practice for some years to provide sand in boxes or in piles, to be used when and where the pavements become dangerously slippery. Applying this by shovel is not only unnecessarily wasteful of the sand, since the vehicles scatter a large part of it into the gutters, but it is difficult to cover all the surface in this way; and in the case of cities it is especially undesirable because the sand is washed into the sewers. Partly to meet the last objection, some cities use cinders, which are washed through the catch basin and sewer more readily than the heavier sand; in addition to which they afford good traction because they bite into the ice.

Whichever is used, the minimum amount possible to throw upon the ice is usually as effective as a larger amount and is less objectionable to either the automobilists or the sewer department and is, of course, more economical than use of it in excessive amounts. The only practicable way of spreading a uniform minimum amount of sand or other gritty material would appear to be by machinery, and several distributors are on the market which are designed especially for spreading sand on pavements and smaller ones for performing the same service on sidewalks.

It has been found of great advantage to mix a small amount of calcium chloride with material used on ice, as this will almost instantly cause sufficient melting to prevent the material being blown away or scattered by traffic. As little as 25 lbs. of calcium chloride to a ton of sand or other gritty material will be sufficient for the purpose. Larger quantities up to 100 pounds per ton can be used where it is desired to melt the ice or snow. The material should be as fine and as uniform in size as possible, since the finer the material the greater the area it will cover. Sand, even when unmixed with calcium chloride, helps to thaw the ice and snow by holding the heat of the sun.

As a rule, for the first application following sleet or ice a single streak of material put down in the center of the road will be sufficient to prevent serious danger, as it is possible for traffic on both sides of the road to keep the wheels on one side of the car on the sanded area.

Special attention should be paid to sanding intersections, especially where there are stop lights or dangerous hills. The safety engineer for the city of Grand Rapids reported that 67% of all motor vehicle accidents there occur at intersections, and that 37% of these are due to slippery pavements.

Bridges are another source of trouble, both because the approaches are frequently steep and also because, being exposed to cold below as well as above, freezing takes place at a higher air temperature than in the case of roads and streets.

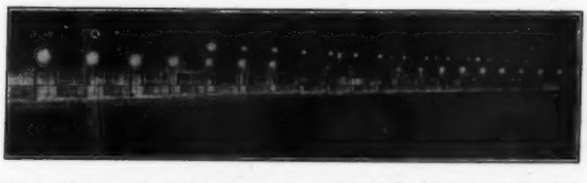
Sanding also is desirable in summer weather when the pavements are wet and damp, especially for wood block pavements. Water combining with the oil dropped by automobiles forms an emulsion which acts much like soap.

For mechanical spreading of the sand, the same machinery may be used which is used for distributing sand, screenings, etc., in road construction work and for spreading calcium chloride for dust prevention, etc.

Golf by Electric Light

Because business men have little leisure except after dark or during twilight, and because, during hot weather, exercise after the sun goes down is more agreeable than during the day time, there are advantages in being able to so light golf courses, tennis courts, and the like, that they can be used after sunset. At Cleveland, Ohio, there is an electrically lighted golf course—a practice course, however, rather than one of regulation size—in nightly operation. In addition to the course itself, there is a row of forty fairly commodious booths, open only on the side toward the course, well lighted, in which players can practice hittting golf balls continuously, the supply of balls being unlimited. At the end of every

PROFESSIONALS MAKING DRIVES AT NIGHT



ILLUMINATED BOOTHS IN WHICH GOLF NOVICES MAY PRACTICE AT NIGHT

50 minutes, a signal bell announces an interval of ten minutes, during which caddies run out upon the course and retrieve the balls. Shots may be made of lengths varying from 50 yards to 275 yards. There are two 18-hole putting greens and a miniature 9-hole course complete, where an entire game can be played. The longest drive on this course is 60 yards.

The illumination was planned and installed by lighting engineers of the General Electric Co. Incandescent lamps of 1000 watts are employed. Six of them, mounted in projectors, giving a narrow beam of high candle power, illuminate the golf balls during shots to far distances. Sixteen others, equipped with projectors giving a broad beam, illuminate the balls during shots at nearer distances. The total illumination is equivalent to about 5000 candles. Professional golfers have stated that they can follow the ball even more readily than in the day time because, with the light shining on it, it is a white spot well defined against a dark background.

An Irish Water Power Development

The Shannon is the longest river in Ireland, the total length exclusive of the tidal estuary below Limerick being about 160 miles. At Killaloe, about 15 miles above Limerick, it has a catchment area of over 4,000 square miles, about one-eighth of the total area of Ireland. In its course it passes through three large lakes, Allen, Ree and Derg, and in this section has a fall of only 55 feet in 125 miles, and flooding of the lands adjacent to the river has been a constant source of trouble. Below Killaloe, the river falls over 90 feet in the 15 miles to Limerick, which fall is now being utilized for production of power.

The state asked four foreign engineers to study the problem of this river and report on it, and these engineers, emphasizing the importance of the drainage problem, recommended that the government have a drainage plan prepared for the areas subject to flooding, in connection with lake and river regulations necessary for developing power. They reported that the hydro-electric exploitation of the river could be combined with flood prevention, while a part of the electrical energy developed might be used in draining areas subject to flooding in other parts of the country as well.

Fortunately, extensive records of observations existed, as regards both rainfall in this area and water level at various points along the river. The course naturally would be to use the lakes as reservoirs for storing the flood waters, but this would mean either raising the level of the lakes and thus flooding neighboring lowlands, or lowering the level of the lakes when the storage water was used, which would interfere with navigation on the lakes. For the present it is proposed to partially develop the river by using only the lower lake, lake Derg, for storage other than that already obtainable, providing for lowering this lake two feet in a dry year, which will make available the storage of 5,280,000,000 cubic feet. At the same time, the shore would be banked at places and the land behind it drained by pumping into the lake. The final development will consist in raising the maximum water level of Derg by nearly seven feet, by which the storage of the three lakes will be increased.

The present development consists of a diversion of part of the Shannon river along the head-race to a power station, where there is a fall of about 100 feet to the river below. The tail race here is affected by the tide and the net fall varies from 86 feet to 115 feet, the average tide giving about 94 feet.

The headwork includes a dam which will raise the river level about 23½ feet above the present average level, which dam is provided with sluice gates which control the amount of water going down the river and to the head-race respectively. The head-race is more than 7½ miles long from the intake to the power house. At the power house there will be six steel penstocks each 20 feet diameter and 145 feet long only three of which are being built at present. There are three Francis turbines each with an output of 38,600 h. p., having vertical shafts direct-connected to 30,000 k. w., 10,500 volt, 50 cycle generators. The voltages will be stepped up to 100,000 volts and to 38,000 volts and distributed over the whole of the Irish Free State by overhead high-tension transmission lines. The 110 k. v. lines will run to Dublin, 116 miles, and to Cork, 59 miles; while the 38 k. v. system is designed for the loop distribution, which will extend about 1,040 miles.

Notes of Los Angeles Engineering Department

From the Annual Report for the Year 1928

The city engineer of Los Angeles, Calif., reports that during 1928 the average monthly output of blueprints by his division was 135,000 square feet, or about 5,000 square feet per day; or a total of more than one and a half million square feet for the year. This includes work of blueprinting, photo copies of the survey division field books and various kinds of mounting. This division does all the blueprinting, photo copying and map mounting of all city departments, which means a saving of several thousand dollars to the city each year.

During the year 1928, 163,306 tons of garbage were collected in Los Angeles, 212,542 cubic yards of domestic non-combustible rubbish was hauled by the can collection division, and 37,781 tons of combustible rubbish was dumped at the city incinerator. The amount of garbage collected was 40% greater than during the previous year. Assuming an increase in population of 10% during the year (which is about that estimated by the health department) gives a per capita increase in garbage of 27%. (No explanation of the per capita increase is given in the report; it was probably due largely to more thorough coverage of the population rather than increase in per capita garbage production).

In connection with the estimate by the health department of an increase in population from some 1,200,000 to 1,300,000, the bureau of water supply reports having installed approximately 9,100 active domestic services. If we assume 5 consumers per service, this would mean an addition of less than 46,000 consumers. On the other hand, there was an increase in the daily domestic consumption of water of about 17%, which would indicate an increase of 200,000 in population if the per capita consumption remained the same.

This 17% increase in domestic consumption of water and 40% increase in amount of garbage collection would seem to indicate that the health board is conservative in claiming a 10% increase in population during the year, or else that the people are

rapidly becoming extravagant in the use of water and waste in the kitchen.

Now that the President has signed the Boulder Canyon Bill, it is probable that Los Angeles will be able to realize a return from the $1,200,000 which the city has spent since 1925 in surveys, investigations and estimating cost of utilizing the water of the Colorado river as a supply for that community. In 1925, the city voted a $2,000,000 bond issue for making such surveys and investigations, but up to the first of this year only $1,200,000 of it has been spent.

The continued ocean disposal of the screened sewage of the city of Los Angeles at Hyperion requires that this city arrange for the removal of grease and oil from the sewage before disposal and also for a probable chlorine treatment of the flow in the outfall sewer. This division is making surveys and demonstrative tests to determine what arrangements are needed to fulfill these requirements.

Limiting Time for Parking

How extensive is the practice of limiting the time that autos may park in the business section of a city and how successful is the enforcement of this, were questions asked of all of the cities and villages of New York State by the State Bureau of Municipal Information during June of this year. Through the courtesy of William P. Capes, the secretary, we have been furnished with a copy of the replies. From these we learn that 54 of the 67 communities limit the time that autos may park. The most common time is one hour, 27 having this limit. Seven have a 2-hour period, six a 30-minute period, five have 30-minutes and 60 minutes, three have 30 minutes and 2 hours, and there is one each of the following combination: 15 minutes, 30 minutes and 60 minutes; no parking, 15 minutes, and 60 minutes; 5 minutes; 20 minutes; 30, 60 and 120 minutes. Forty-four report that in their municipalities these regulations are enforced, seven that they are not, three that they are not very strictly enforced; while two report liberal enforcement.

Only ten report any difficulty in enforcing the ordinance, and three others very little difficulty. Of the cities, one states that this requires constant effort and the motorists object to it, another that it requires constant police supervision, a third reports that an occasional arrest is required. Of the eighteen villages only two report any difficulty in enforcing the law and one of these finds difficulty with local people only.

The question was asked, "Do you believe that your parking time limits are a success? Why?" Three reported that they did not consider them a success; one, because merchants complained that it hurt their business; another, because the time limit was too long (2 hours was the limit in this village); and the third, because the ordinance is not enforced, there being no parking spaces in the business district. One city reports one-hour parking a success and anything less too short a time; another with one-hour parking thinks half-hour parking would be much better in the congested parts of the city. A third, with 5 minute parking, believes this a success, this city having two large parking spaces near the business section, each holding about 300 automobiles, where the cars can be parked free for an unlimited period, and this official believing that more than 5 minutes is practically unenforcible as it requires too much police supervision.

The majority of the cities report that the worst offenders, before parking regulations were adopted, were merchants and their clerks who would park their cars all day in front of or near their places of business. One reports: "I find the violations by persons who park to do shopping are very few. Our greatest problem has always been the merchants, lawyers, stenographers, clerks, and the professional class who are always using the streets for parking."

One city has just adopted a regulation by which parking permits will be issued by the traffic officers stationed in the commercial or congested districts to persons applying for them and requesting more than one hour limit for business purposes only.

Subway Crossings for San Francisco Boulevards

To permit of the safe crossing of the boulevards now under construction in San Francisco, Calif., and also on a number of existing thoroughfares, the city engineer's office is having constructed several subways for the use of pedestrians. These subways are located after conference with the Police Department, the Board of Education, and other interested bodies.

The standard subway is a tunnel six feet wide by seven feet three inches high, reached by stairways five feet wide, located within the sidewalk lines. The stairway, with its balustrades, is a serious encroachment on the sidewalk width, especially where the sidewalk is as narrow as twelve feet. Additional sidewalk width is obtained in some cases by the purchase of a few feet of land. On one curve, the use of different curvature at the curb line from that at the property line gave all the necessary additional width of sidewalk.

The most desirable depth is with floor about eleven feet below curb grade. Such a depth, however, requires special treatment of sewers. In some cases, these have been offset to pass around the stairway within the sidewalk area.

Drainage of the subway is either direct to sewer or to a small sump, from which the accumulated water may, from time to time, be drawn off to a sewer by use of an ejector operated from the city water pipe.

Water, gas, electric and other conduits will pass through the space between the top of the subway and the bottom of the pavement.

Two types of construction are used: a standard section for crossing under ordinary streets, and an extra heavy section under main line steam railroad tracks. Lighting is supplied by lamps set in recesses at about twenty-foot intervals on both sides of the subway, so arranged that they cannot readily be stolen.

Municipal Airport Conference

A municipal airport conference will be held in Washington, D. C., on October 24 and 25 under the auspices of the City Officials' Division of the American Road Builders Association. Among the subjects that will be presented for consideration are: Factors to be considered in the selection of airport sites; transportation and traffic regulation adjacent to airports; airport management, housing and building control; European practices; the design of runways, landing areas and field surfacing; airport drainage; relation of airports to public parks, and public attendance; and airport finance.

Papers on the above subjects will be presented by qualified specialists.

Designing Airports

Should serve as amusement grounds and tourist camp, with hotel and aircraft repair plant, in addition to providing hangars and runways. Requirements of location and construction

A paper was read before the Louisiana Engineering Society a few weeks ago entitled "Layout, Design, and Rating of Airports" by Raymond Saal, general manager of the New Orleans Airport Commission, in which Mr. Saal gave a general and brief presentation of the subject, accompanying it with application to New Orleans local conditions. The portions of his paper which are of general applicability are abstracted in the following paragraphs:

In its present stage of development, aeronautics should be made as popular as possible to the masses and everything should be done to encourage their interest and a closer contact with aviation. The airport, therefore, within reasonable limits, should be open to the public for their enjoyment, amusement, education and convenience. To the spectators it is in the nature of a circus ground. It is also a tourist camp, where a portion of the air-traveling public more or less camp in the open air; while for others there must be a hotel where reasonable hotel accommodations can be expected and obtained. It must also be an aero repair plant where any type of aircraft may be rehabilitated by expert crews of workmen.

It must be available for use during night as well as during the day time and the personnel of the airport should therefore be in attendance at all times and service of every kind should be available 24 hours every day.

The Templehof Airdrome in Berlin, Germany, is the best outstanding example of today's modern airport. It is excellently located near the center of Berlin on a tract of land which was formerly the Kaiser's parade ground and is probably the most active airport in the world. It is surrounded by amusement buildings of not great height, on the roofs of which are located restaurants, roof-gardens and beer gardens, and it is customary for large numbers of people to congregate there daily, watching the operations and becoming familiar with the manner in which aircraft are handled. This not only has a tendency to amuse, but it destroys the natural fear of flight and has the greatest value in educating the people toward air-mindedness.

Mr. Saal believes that it will be many years, five or ten in all probability, before any airports, in the southern part of the United States at least, will be self-supporting. Till such time, they must be viewed largely in the nature of public parks, and in order to keep any given municipality abreast of its neighbors, they must receive the highest type of municipal and public support. Recently a number of large national corporations have gone into the airport business, but it is believed that the largest stockholders in these are the manufacturers of aircraft who feel the necessity of creating airports in order that operation of their larger and better aircraft may be practicable and a market be made for them.

There are four usual types of airports, known as two, four, six and eight-way fields. Each straightaway naturally provides landings and take-offs in two directions, so that each straightaway would be a two-way field. Four straightaways, each 500 feet wide, permitting landing in at least eight directions at all times, and converging at angles of not less than 40 degrees, each straightaway being at least 2500 feet long and with clear approaches, makes for the very best type of landing field.

Although a comparatively small area is needed for the landing of one airplane, modern airports need or soon will need to handle a number of aircraft at the same time, and therefore will need large fields. Aircraft should be able to come into municipal airports in droves and take-off in droves.

The 2500 foot length is based upon sea level, but at higher altitudes a greater length is necessary, since the atmosphere does not have as great buoyancy, and greater speed must therefore be employed by the planes when landing and taking off, which, of course, necessitates longer runways. At 1000 elevation the runway should be 2600 feet, at 5000 feet it should be 3,600 feet, and at 10,000 feet, 6,200 feet, according to the figures given by the United States Department of Commerce.

There is required not simply an area approximately 2500 feet square (or greater, depending upon the altitude), but the soil of the field should be firm and level, with suitable approaches well-drained, and without obstructions or depressions presenting hazards in taking off or landing. Fields should preferably be heavily sodded with Bermuda grass and kept closely cropped. Roads should not cross any part of the landing area, but the entire landing area should be open and available for landing and taking off of aircraft only and be used for no other purpose. The field should not have a maximum slope at any point of more than 2½% and the mean slope of the entire surface should not be more than 2%.

The sites should be free from surrounding obstacles, for such obstacles will diminish effective landing area by seven times their height. For instance, obstacles 50 feet high along the border of a field will diminish the available landing area along that side by 350 feet.

In referring to drainage of the field, Mr. Saal says that farm drainage, in which the water is permitted after a heavy rain to remain on land for two or three days, would be not at all satisfactory; nor would what he calls golf course drainage, in which the water may remain for perhaps one day. Airport drainage should be such as to carry water from the landing area as fast as it falls. This is one of the most important features in selecting and constructing an airport. No amount of money should be spared to accomplish this purpose, for without the very dryest kind of drainage, airports may for thirty per cent of the time be valueless. "Curtail embellishments in other directions, if funds are limited, in order to put the necessary amount of money into adequate drainage. It is impossible for me to stress this point too greatly."

The direction of the prevailing wind is important, as airplanes should land and take off directly into the wind. Cross wind landings may be made by competent pilots, but this is contrary to air traffic rules except in emergencies or for instruction or test purposes.

Aircraft need good air speeds to insure stability, but at the moment of contacting the wheels of the aircraft with the earth, there should be a minimum of ground speed, in order to lessen the landing strain. A landing or take off with the wind would greatly increase the ground speed, and one across the wind would place the strain on one side of the landing gear instead of on the revolving motion of the wheel. When an airport is not available for landing in all directions, the longest landing strip should lie in the direction of the prevailing wind.

Pole lines should be particularly avoided in site selection, for in addition to being obstacles, telephone, light or power wires carried on poles at the edges of fields constitute a serious menace. Pilots will usually attempt to glide in close to the edge of the field, and often such wires are nearly invisible, and the risk of catching the landing gear in them is always present and such an accident is apt to be serious. If the wires carry high voltage, the danger is, of course, increased. All wires along the boundaries of flying fields should be placed under ground or removed to a distance more than seven times their height.

One of the greatest hazards in flying, and particularly in night flying, is fog, and even expert pilots find great difficulty in flying through it. Landing safely in a fog is practically impossible with present equipment, and a proposed site which lies in a section frequently affected by fog should not be chosen under any circumstances.

Smoke also creates a very serious situation and, especially in industrial centers, the presence of smoke is a great menace to flying. Birmingham, Alabama has an excellent flying field only four miles from the city, but unfortunately it is located in a hollow near some very large steel plants and it frequently happens that pilots are unable to locate the field on account of the presence of thick black smoke.

An airport should be located the least possible distance, measured in time of automobile travel, from the business center of the city. The route connecting the two, therefore, should not only be short but have such a surface and width of pavement that good speed can be made upon it at all times.

Mr. Saal has serious doubts whether it will ever be practicable for aircraft to land and take off practically perpendicularly; on the other hand, it appears that the tendency is toward larger aircraft, requiring longer runways; he therefore recommends the selection of sites which can in the future, if necessary, be expanded beyond the 2500 feet square area called for by present conditions.

By means of zoning ordinances or in some other way, assurance should be had that the approaches to the airport site will not be restricted by the erection of high buildings.

It is also desirable to have the airports surrounded by as many available open fields as possible, since aircraft motors have the bad habit of developing most of their troubles shortly after the load has been placed upon them and of going dead shortly after the take off.

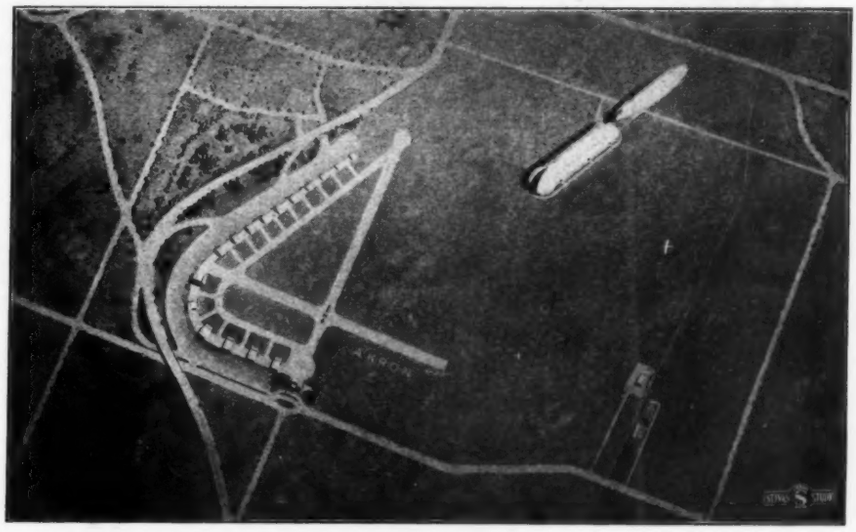
Finally, he states that consideration should be given to local air currents and eddies near the proposed site, which might add materially to the hazards of flying. In addition to meteorological reports on proposed sites, actual test flights over the suggested site should be made under varying conditions to determine the existence and extent of such air currents.

The Akron Municipal Airport

The Akron, O., municipal airport is one of the most notable in this country not alone because of its size—890 acres of land—but also because of the care taken in selecting and developing the site, and especially because there is being constructed there the largest airship dock in the world.

The land at and around Akron is rolling and hilly, and it was difficult to find a suitable site. For several years all sites within ten miles of the city were studied by experts. The one selected is on the Great Divide, above possibility of flooding, but sheltered on two sides by hills, and approved by the foremost pilots and aeronautic authorities in America. It is only four miles from the center of the city and one mile from the plant of the Goodyear-Zeppelin Corporation, which is building the airship dock and will manufacture there two airships for the United States Government, each having two and a half times the gas capacity of the "Los Angeles" and nearly twice that of the "Graf Zeppelin."

The airport is 1040 feet above sea level and unusually free from fogs. The prevailing winds are from the southwest and the horizon in this direction is very low. It is at the junction of two state highways, surrounded by paved roads and nine paved roads lead to it, four running to the city, the center of which can be reached in twelve minutes.



AKRON AIRPORT AS IT WILL APPEAR WHEN COMPLETED
At the left center are the runways and hangars. Just above the center is the airship dock and a zeppelin leaving same

Since the beginning of the development, less than a year ago, water service has been extended to the port, a storm sewer for surface and underground drainage has been constructed, and more than half of the million yards of grading necessary has been completed. Plans are completed for a sanitary sewer to serve the buildings. Electric lines serve the port and telephone and gas lines will be extended when needed. A level part of the area 2,000 feet long is being used as a temporary landing field for air mail and passenger planes, and is lighted with the necessary boundary, obstruction, flood and beacon lights.

When fully developed, the port will have runways in eight directions, one, in the direction of the prevailing wind, 5,000 feet long, the others 2,500 feet. Adjoining this area will be the airplane hangars arranged in a semicircle, the hangars being uniform in shape, color and type of architecture.

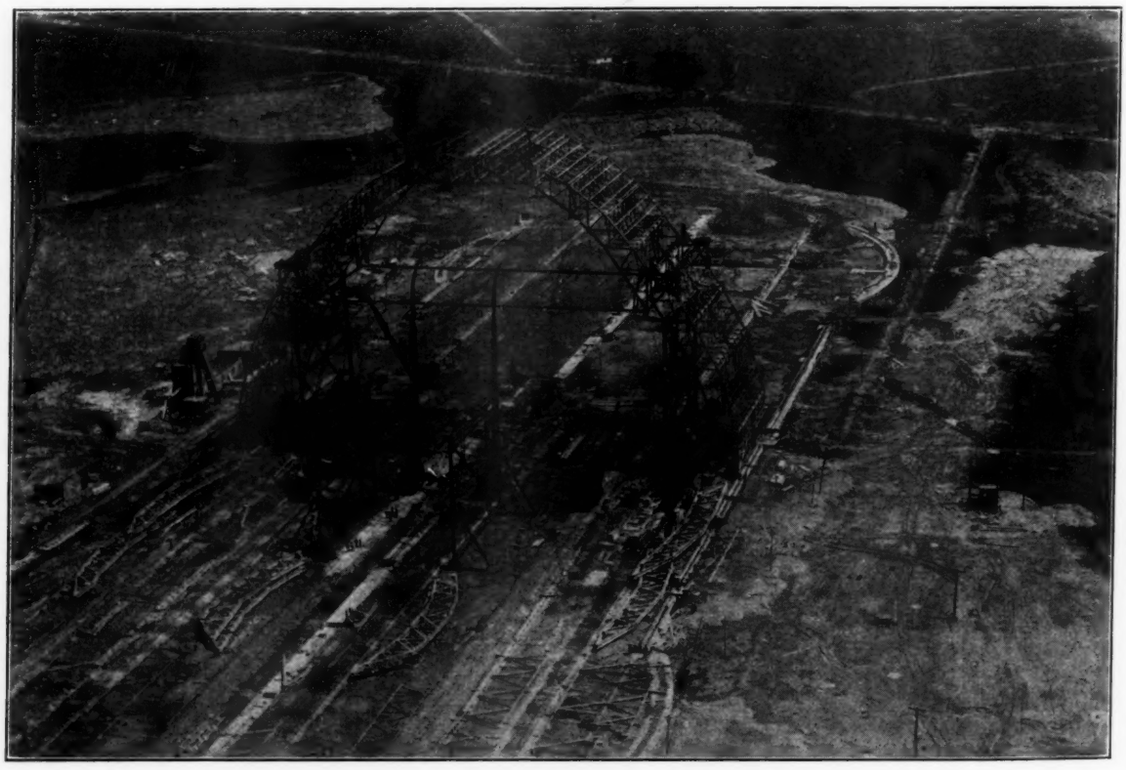
The large airship dock referred to is being built in an area ¾ mile long and ½ mile wide assigned to lighter-than-air ships.

After the grading has been completed the entire surface of the field will be sown with grass seed. The runways will be surfaced progressively. About 150 acres around the boundaries of the port and above the level of the runways will be available for parking automobiles and give a view of the port. In order to complete the port, it will be necessary to relocate two main highways and two miles of the B & O Railroad. The territory around the airport is zoned to protect the horizon of the port.

The entire project, covering land, grading, drainage and lights, will cost about $1,500,000. The work is being done under the direction of the city, of which G. Lloyd Weil is mayor-manager. Fred E. Swineford, director of public service; E. A. Kemmler, engineer; A. R. Barbiers, resident engineer, and B. E. Fulton, airport manager.

The airship dock not only is the largest in the country (it is 1200 feet long by 325 feet wide, all under one arched rooof), but the structural frame differs from others in that it consists of a series of arch trusses, giving the shell an approximately parabolic cross-section, and the doors are spherical in shape. The construction requires 7,000 tons of steel and 10,000 cu yds. of concrete. The longitudinal axis lies in the direction of the prevailing wind. The arches supporting the main shell are spaced 80 feet apart and carry a bracing system composed of horizontal and vertical trusses, which in turn support rafters spaced 10 feet apart, which carry sub-purlins spaced on 8 ft. centers, to which the roofing plates are attached. The middle arch is attached to its base and the others are on rollers to allow for contraction and expansion. Under its contract the American Bridge Co. is to complete half of the steel superstructure by August 15th; then the metal siding and roofing will be put on this half while the steel for the other half is being erected. Work on one of the airships will begin as soon as one half of the building has been completed.

In erecting an arch, about one-fourth of the structure is erected on each of the foundations; the middle half meantime is constructed on the ground, and is then raised as a unit into place by means of four railroad cranes with 100-foot booms, and eight counterweights; the weight of the central arch being 380 tons. When raised to the necessary height and position, the central arch is then fastened to the tops of the haunches.



COMPLETING THE FIRST ARCH OF THE GOODYEAR-ZEPPELIN AIRSHIP DOCK
The central section of the arch is being raised between the haunches and has nearly reached its position

Recent Legal Decisions

SEWAGE COMMISSIONERS HELD ENTITLED TO CONSTRUCT STORM WATER OUTLET CONNECTING WITH SEWERS

The Court of Appeals of Kentucky holds, Bickel v. Commissioners of Sewerage of City of Louisville, 6 S. W. (2d) 1112, that a city could not be enjoined from constructing a storm water outlet into which sewers would overflow where expert sanitary engineers testified that, when such overflow occurred, the proportion of objectionable matter in the stream would be so small as to be harmless under the safeguards provided and its construction and operation under the plans proposed had met with the approval of the state board of health. If the theory of the experts and engineers should not work out in practice, and the outlet should erode or scour, causing pools to form which should become stagnant and a nuisance, on a showing of such a condition the nuisance might be abated by injunction.

CHANGE IN ORDINANCE APPORTIONING COST OF IMPROVEMENTS

The Kentucky Court of Appeals holds, City of Princeton v. Baker, 7 S. W. (2d) 1042, that the work done on street improvements and contracts let therefor must be in accordance with the statutory requirements governing the same. Without that no apportionment can be made against the abutting property owner, and any payment made by him would be purely voluntary on his part. If the apportionment ordinance cannot be enforced by the city, it may be enjoined by any aggrieved property owner from going ahead with the work or the contract. Where a city adopted an apportionment ordinance, but let no contract for an improvement in accordance with the statutory requirements governing the improvement of streets, instead buying material and employing laborers in the construction of streets, the city may, by a subsequent ordinance, change the plan of apportionment provided for by the first ordinance.

PROVISION FOR PER DIEM PAYMENT AFTER EXPIRATION OF TIME FOR COMPLETION HELD PENALTY, NOT LIQUIDATED DAMAGES

In determining whether a clause in a contract for the construction of ditches and drains for a drainage district, providing for the payment of $10 per day for all the time required for the completion of the contract after the expiration of the three years allowed therefor, is a provision for a penalty or for liquidated damages, the Arkansas Supreme Court, Lasater v. Western Clay Drainage Dist., 8 S. W. (2d) 502, gave effect to the rule that the intention of the parties on this question is controlling, and also gave weight to the practical construction of the contract by the parties, resolving any doubt as to its meaning against the party who prepared it. Tested by these rules, the court held the provision was one for a penalty, and not for liquidated damages, and was unenforceable in the absence of any proof of actual damages sustained by the district. The contractor's bond indemnified the district against "all damages" it might sustain by a breach of the contract, and the drainage directors themselves in resolutions referred to the stipulation as a penalty.

UNAUTHORIZED SALE OF MUNICIPAL LIGHTING PLANT

The Kentucky Court of Appeals holds, Russell v. Bell, 6 S. W. (2d) 236, that the sale of a lighting plant belonging to a city of the second class by the boards of aldermen and councilmen without the enactment of an ordinance as prescribed by Ky. St. § 3058, 3059, is unauthorized and void. Although the members of these boards were necessary parties to a suit for cancellation of the contract of sale, it was held that, in the absence of fraud, the plaintiff taxpayer could not recover a judgment against such members for the difference in the value of the equipment and the price for which it was sold.

CITY LIABLE ONLY FOR STREAM POLLUTION DAMAGE CAUSED BY ITSELF—PLEADING DEFENSE OF ACTS OF OTHERS

The Texas Court of Civil Appeals holds, City of Corsicana v. King, 3 S. W. (2d) 857, that where the acts of different parties contributed to cause a nuisance, a party sued alone and charged with being responsible therefor was liable only for the injury caused by his own acts. Although sewage discharged by a city into a stream may have created a nuisance therein, if offensive refuse was carried into the stream from other sources and contributed appreciably to the nuisance, the city would not be liable for the entire damage sustained by adjacent landowners, but only for such damage as resulted directly or proximately from its own acts.

In an action against the city to abate the nuisance of the pollution of a stream by the discharge of sewage therein from its sewer system, it was held unnecessary for the city to plead that the acts of other parties caused or contributed to the nuisance complained of. Testimony tending to sustain such contention was admissible under its general denial. But where the city elected to interpose such contention as an affirmative defense by specific plea it thereby assumed the burden of establishing the facts so alleged.

STATUTE REQUIRING OWNERS TO REMOVE WEEDS AND BRUSH FROM HIGHWAYS HELD CONSTITUTIONAL

In a prosecution for the violation of Kentucky St. §§ 4342 a 1, 2, 3, requiring owners and occupants of land to remove from the highway bordering their premises brush, weeds, and similar obstructions, the Kentucky Court of Appeals said, Commonwealth v. Watson, 3 S. W. (2d) 1077: "The ground on which the statute was held unconstitutional [by the circuit court] is that it is discriminatory, and takes private property for public use without due compensation. While there is authority to the contrary [citing cases], the weight of authority and the better reasoning is to the effect that the Legislature of a state may authorize a municipal corporation by ordinance to require property owners to remove snow and ice from sidewalks in front of their property [citing cases] * * * The doctrine announced in the foregoing cases is clearly applicable to the question under consideration, for if the Legislature may authorize a munici-

pality to require the owners or occupants of property to remove the snow and ice from the sidewalks in front of their premises, certainly the Legislature has the power to require the owners or occupants of land to remove weeds, brush, and other obstructions from the highways adjoining their premises. * * * We are therefore of the opinion that the statute is valid. A similar conclusion was reached by the Supreme Court of Washington in Northern Pac. R. Co. v. Adams County, 78 Wash. 53, where the court upheld an act requiring the owner of land abutting on the public highway to cut noxious weeds growing upon the highway and making the cost thereof a lien on his land.

REPAIR PARTS FOR EQUIPMENT AND REPAIR LABOR NOT WITHIN INDIANA STATUTORY PUBLIC WORKS BOND

The Indiana Appellate Court, Montgomery v. Southern Surety Co., 162 N. E. 31, holds that repair parts for the equipment of a contractor for the construction of state roads, and items of labor performed in repairing such equipment, which included trucks, Ford cars, mixers, tractors and tools, were not the basis for a claim against the surety company on its statutory bond, none of these items having entered into and become a part of the work, or having been consumed in its completion. "The purpose of the statute is to furnish protection to those who furnish material or labor which enters into or becomes a part of, or is naturally consumed in or about, the completion of the work involved."

PROOF OF WAIVER OF DAMAGES FOR DELAY IN COMPLETING ROAD CONSTRUCTION SUBCONTRACT

In an action by subcontractors against contractors to recover under a contract by which work on a proposed road was let by the plaintiffs, the plaintiffs being bound to do the work in strict conformity with the contract between the defendants and the state highway commission, the subcontract provided for completion within 100 working days of the work that was sublet. The defendant insisted that, according to the plaintiffs' own evidence, the time had expired long before the work was done; but a member of the defendants' firm testified that the defendants made no claim against the plaintiffs for holding up the contract and that he did not know how long they took, and that the defendants based their defense on insufficient performance of the contract. The North Carolina Supreme Court held, Porter & Peck v. West Const. Co., 195 N. C. 328, 142 S. E. 27, that this was, in effect, an admission on the part of the defendants that they sought no damages against the plaintiffs for delay in performing their contract.

TIME FOR NOTICE BY MATERIALMAN TO CONTRACTOR'S SURETY

In an action by a materialman who had furnished materials used in paving construction by a public contractor, on the statutory bond, it was held that where the work was substantially finished on a certain date, but it had not been completed in accordance with the plans and specifications and a maintenance bond was given, substantial performance was not all that is contemplated by such a bond, and notices given the surety within 90 days of acceptance by the village were in time. Moose Lake Land & Gravel Co. v. American Surety Co. (Minn.) 220 N. W. 958.

MUNICIPALITY'S DISCRETION AS TO LIMITS OF PAVING DISTRICT

In a suit to restrain a city from entering into a paving contract on the ground of improper inclusion of property in the paving district, the Nebraska Supreme Court holds, Salsbury v. City of Lincoln, 220 N. W. 827, that the matter of improving the streets, alleys and highways within the corporate limits of a municipality is a subject strictly of municipal concern. Courts will not inquire into or endeavor to control the legislative discretion of city councils in establishing the boundaries of paving districts.

JOINT ADVENTURE CONTRACT FOR CONSTRUCTION OF ROAD

The successful bidder for a state road construction contract entered into a written contract with the owner of the necessary equipment and machinery for doing the work, the bidder agreeing "to furnish all material and supplies and to pay for the same, and also to pay all pay rolls," and the contractor agreeing to "furnish all tools, machinery and equipment necessary" without cost to the bidder and "to devote his time and attention to the work," the profits to be divided "after deducting all expenses in connection therewith." The bidder was a corporation, and had other contracts for similar work. In an action for an accounting growing out of the joint adventure, it was held, McDermott v. Rossney Contracting Co., 228 N. Y. Supp. 1, that the corporation could not charge a proportion of the general expenses in the management of the company as an expense against the cost of the construction of that particular road, there being no provision in the contract therefor. The corporation agreeing to furnish all material and supplies and to pay for the same, and also to pay all pay rolls, a charge for interest on money borrowed or loaned for the performance of the work was held unauthorized.

BUILDING OF AIRPORT HELD A CITY PURPOSE

The New York Appellate Division holds, Hesse v. Rath, 230 N. Y. Supp. 676 that New York Laws, 1928, c, 647, authorizing towns to maintain airports and landing fields, is not unconstitutional as in violation of section 10 of article 8 of the state Constitution, providing that municipalities may not incur indebtedness "except for county, city, town or village purposes." The court said that what constitutes "a city purpose" within the meaning of the constitutional provision cannot be stated with exactness. The question of what is a public purpose is a changing question, changing to suit industrial inventions and developments and to meet new social conditions. The provision must be construed in view of conditions existing at the time when the question was raised. A statute held to be unconstitutional at one time may, at a future day, in view of changing conditions and new light upon the subject, be held to be constitutional. The court took judicial notice of the fact that aviation is no longer an experiment, and in view of its extensive development and the purposes for which air transportation is used, it held that the Legislature was justified in determining that the building of an airport is "a city purpose."

Engineering Societies

Aug. 25-27—AMERICAN ASSOCIATION OF ENGINEERS. Annual Convention at Mexico City. M. E. McIver, Secretary, Chicago, Ill.

Sept. 17-20—NEW ENGLAND WATER WORKS ASSOCIATION. Annual Convention at Portland, Me. F. J. Gifford, Secretary, 715 Tremont Temple, Boston, Mass.

Sept. 30-Oct. 4—AMERICAN PUBLIC HEALTH ASSOCIATION. Annual Convention at Minneapolis, Minn. Homer M. Calver, Secretary, 370 Seventh Ave., N. Y.

Oct. 14-16—SOUTHWEST WATER WORKS ASSOCIATION. Annual Convention at Tulsa, Okla. L. A. Quigley, Secretary, Fort Worth, Tex.

Oct. 14-16—INTERNATIONAL ASSOCIATION OF STREET SANITATION OFFICIALS. Annual Convention at Jacksonville, Fla. A. M. Anderson, Secretary, 100 North LaSalle St., Chicago, Ill.

Oct. 14-18—AMERICAN SOCIETY FOR MUNICIPAL IMPROVEMENTS. Annual Convention at Philadelphia, Pa. C. V. S. Sammelman, Secretary, St. Louis, Mo.

Oct. 28-Nov. 1—ASPHALT PAVING CONFERENCE. Eighth Annual Meeting at West Baden, Ind. J. E. Pennypacker, Secretary, 441 Lexington Ave., N. Y.

Nov. 12-14—NATIONAL MUNICIPAL LEAGUE. Annual Convention at Chicago, Ill. Secretary, Russell Forbes, 261 Broadway, N. Y.

Nov. 20-23—INTERNATIONAL CITY MANAGERS' ASSOCIATION. Annual Convention at Fort Worth, Tex. Executive Secretary, John G. Stutz, Lawrence, Kans.

Jan. 11-18—AMERICAN ROADBUILDERS' ASSOCIATION. Annual Convention and Road Show, Atlantic City, N. J. C. M. Upham, Director, National Press Building, Washington, D. C.

American Road Builders' Association

One of the major projects urged before the second Pan American Highway Congress at Rio de Janeiro in August by the United States delegation will be immediate action toward early completion of the Pan American highway to link the farthest reaches of the northern and southern Americas.

President Hoover has named to represent this country in Brazil a group particularly well equipped to interpret road building progress in the United States to the Latin nations.

Major Frederic A. Reimer, East Orange, N. J., President of the American Road Builders' Association and a consulting civil engineer by profession; Charles M. Babcock, St. Paul, Minn., Commissioner of Highways of that state, a past president of the American Road Builders' Association and present member of its executive and highway finance committees; from Congress, President Hoover selected Senator Tasker L. Oddie, Nevada, member of the Senate post office and post roads committee, and Representative Cyrenus Cole, Iowa; Thomas H. MacDonald, Chief of the U. S. Bureau of Public Roads; Frank T. Sheets, Chief Highway Engineer of Illinois; H. H. Rice, Detroit, Treasurer and Director, National Automobile Chamber of Commerce; and J. Walter Drake, Detroit, former assistant Secretary of Commerce, who will be chairman, complete the delegation.

As official representatives of the President, the group will be formally welcomed to the Brazilian meeting which opens August 16th. After the ten days of conference sessions, with many entertainment features to complement the study of all phases of road building throughout the Western hemisphere, the United States group will study road developments in Uruguay, Argentina, Chile and Peru before returning to the United States in November.

During the tour, the American Road Builders' Association officials will confer with that organization's honorary representatives, of which there are several in each of the twenty-one South and Central American nations. These honorary representatives comprise the Pan American division, headed by Senator Octavio Dubois, Mexico City, president of the National Highway Commission of Mexico.

As a road building project fostered by the American Road Builders' Association for many years, the Pan American highway has tremendous possibilities for tourist and commercial expansion, as well as for betterment of international relations. It often has been referred to by orators and journalists as a "highway of understanding" and a "pathway to permanent peace in the Western world."

Highway Research Board

The Ninth Annual Meeting of the Highway Research Board will be held on December 12 and 13, 1929, in Washington, D. C., at the building of the National Academy of Sciences and National Research Council. An important feature of the meeting will be the presentation of progress reports upon the comprehensive program of highway research now in preparation by the board.

American Institute of Electrical Engineers

Harold B. Smith, Professor of Electrical Engineering, Worcester Polytechnic Institute, Worcester, Mass., and Consulting Engineer, Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa., was elected President of the American Institute of Electrical Engineers for the year beginning August 1, 1929, as announced at the Annual Meeting of the Institute held at Swampscott, Mass., June 25, during the annual Summer Convention of the Institute. The other officers elected were: Vice-Presidents E. C. Stone, Pittsburgh, Pa.; W. S. Rodman, Charlottesville, Va.; Herbert S. Evans, Boulder, Colo.; C. E. Fleager, San Francisco, Calif.; C. E. Sisson, Toronto, Ont. Directors: J. E. Kearns, Chicago, Ill.; W. S. Lee, Charlotte, N. C.; C. E. Stephens, New York, N. Y. National Treasurer, George A. Hamilton, Elizabeth, N. J. (re-elected).

These officers, together with the following hold-over officers, will constitute the Board of Directors for the next

administrative year, beginning August 1: R. F. Schuchardt (retiring President), Chicago, Ill.; Bancroft Gherardi, New York, N. Y.; E. B. Merriam, Schenectady, N. Y.; H. A. Kidder, New York, N. Y.; W. T. Ryan, Minneapolis, Minn.; B. D. Hull, Dallas, Tex.; G. E. Quinan, Seattle, Wash.; I. E. Moultrop, Boston, Mass.; H. C. Don Carlos, Toronto, Ont.; F. J. Chesterman, Pittsburgh, Pa.; F. C. Hanker, East Pittsburgh, Pa.; E. B. Meyer, Newark, N. J.; H. P. Liversidge, Philadelphia, Pa.; J. Allen Johnson, Niagara Falls, N. Y.; A. M. MacCutcheon, Cleveland, Ohio; A. E. Bettis, Kansas City, Mo.

The annual report of the Board of Directors, presented at the meeting, showed a total membership on April 30, 1929, of 18,133. In addition to three national conventions and three regional meetings, 1400 meetings were held during the year by the local organizations in the principal cities and educational institutions in the United States and Canada.

American Society of Mechanical Engineers

The Nominating Committee of The American Society of Mechanical Engineers presents the following nominees for the offices of the Society for 1930; President, Charles Piez, Chairman of the Board, Link-Belt Co., Chicago, Ill.; Vice-presidents, Paul Doty, Chairman of the Board, Minnesota State Board of Registration, St. Paul, Minn.; Ralph E. Flangers, Manager, Jones & Lamson Machine Co., Springfield, Vt.; Ernest L. Jahncke, Assistant Secretary of Navy, Washington, D. C.; Conrad N. Lauer, President, Philadelphia Gas Works, Philadelphia, Pa.; Managers, Harold V. Coos, Ford, Bacon & Davis, New York, N. Y.; James D. Cunningham, President, Republic Flow Meter Co., Chicago, Ill.; Clarence F. Hirschfeld, Chief, Research Department, Detroit Edison Co., Detroit, Mich.

American Engineering Council Delegates: L. P. Alford, Vice-President, Ronald Press, New York, N. Y.; Thomas D. Campbell, President, Campbell Farming Corporation, Hardin, Mont.; William B. Ferguson, Production Manager, Newport News Shipbuilding & Drydock Co., Newport News, Va.; Charles E. Ferris, Dean Engineering, University of Tennessee, Knoxville, Tenn.; John Lyle Harrington, Consulting Engineer, Harrington & Cortelyou, Kansas City, Mo.; William H. Kenersen, Professor of Mechanical Engineering, Chairman, Division of Engineering, Brown University, Providence, R. I.; John H. Lawrence, Vice-President, General Manager, Thomas E. Murray, Inc., New York, N. Y.; Richard C. Marshall, Jr., Sumner Sollit Co., Chicago, Ill.; Charles Piez, ex-officio; A. A. Potter, Dean Engineering Schools, Purdue University, Lafayette Ind.

Diesel Engine Manufacturers' Association

Twelve of the leading builders, representing practically the entire output of Diesel engines in the United States, have organized the Diesel Engine Manufacturers' Association. The association has as its primary object, the advancement of Diesel power in America and a broad program of cooperation with the users of this type of power.

The following manufacturers are members of the Association: New London Ship & Engine Works, Electric Boat Co.; Worthington Pump & Machinery Corp.; Fulton Iron Works Co.; Ingersoll-Rand Co.; Fairbanks, Morse & Co.; Nordberg Manufacturing Co.; I. P. Morris & DeLaVergne, Inc.; Winton Engine Co.; Cooper-Bessemer Corp.; McIntosh & Seymour Corp.; Busch-Sulzer Bros. Diesel Engine Co.; Hooven, Owens, Rentschler Co.

The president of the Association is Henry R. Sutphen, President, Electric Boat Co.; E. T. Fishwick, Vice President of the Worthington Pump & Machinery Corp. is vice president of the Association; and Harlan A. Pratt, Manager Oil and Gas Engine Department of Ingersoll-Rand Co. is secretary and treasurer. The Association also employs M. J. Reed as research engineer, with headquarters at the association office, 30 Church Street, New York City.

Special Course in Military Sanitation

A special course in Military Sanitation was given July 6 to 20, at the Medical Field Service School U. S. Army, Carlisle Barracks, Pa., to reserve officers of the Sanitary and Medical Corps, who were specially chosen for this training because their work in civil life lies in the field of public health.

The course of training included housing, mosquito control, water supply and purification, sewage and waste disposal, camp sanitation, sanitary surveys and sanitary orders. Both classroom and field work was done, and stress was laid on the practical side of the work. Demonstrations of mosquito control, water purification in the field, field waste disposal, food protection and fly control were given, and the officers required to solve actual field problems, as in case of war.

This course, which was first given last year, proved exceedingly popular and valuable to the 63 officers who took it. Of these 25 were members of the Medical Corps, mainly health officers; 35 members of the Sanitary Corps, mainly sanitary and public health engineers; and the remainder were from other branches of the Medical Department.

An interesting feature was the annual dinner of the Order of the Boar, a society formed last year among the officers who have taken this special training in Military Sanitation. The object of this order is the promotion of better training and higher standards among the officers comprising this group.

Major G. C. Dunham was in charge of the course, and was assisted by Major L. A. Fox. The group of reserve officers was under the command of Major W. A. Hardenbergh, who also assisted in the instruction. Officers taking the course included:

Lt. F. D. Aldrich, Maj. R. J. Anderson, Capt. R. E. Andrew, Maj. J. D. Aronson, Lt. H. C. Atkinson, Lt. H. L. Baker, Jr., Capt. W. G. Beucler, Maj. M. J. Blew, Maj. J. L. Bowman, Capt. H. F. Bronson, Lt.-Col. C. P.

Brown, Lt. Floyd G. Browne, Maj. W. A. Brumfield, Lt. J. W. Burke, Lt. H. L. Burr, Lt. R. W. Channell, Maj. F. E. Chidester, Maj. G. S. Clinkscales, Lt. F. M. Comfort, Maj. J. H. Defandorf, Maj. C. H. Dollman, Capt. Louis DuBois, Maj. N. C. Dysart, Lt. George E. Eagle, Maj. J. C. Eldridge, Capt. T. Z. Elinor, Lt.-Col. E. E. Epting, Lt. S. S. Goldman, Maj. E. A. Goldman, Capt. J. F. Granger, Lt. E. J. Guidone, Lt. B. T. Hatch, Lt. W. T. Johnson, Lt. H. C. Jones, Lt. M. H. Knutsen, Lt. N. W. Larkum, Lt. T. M. Logan, Maj. J. A. McDevitt, Lt. S. B. McNair, Capt. S. L. Maloney, Capt. A. R. Middleton.

Capt. W. M. Monroe, Capt. F. C. Mortenson, Col. C. A. Neal, Maj. C. R. Newell, Lt. F. L. Olweiler, Capt. Leopoldo Pardo, Maj. F. P. Sally, Lt. August Sauer, Maj. K. B. Seeds, Lt. S. G. Silverburg, Maj. F. F. Simonton, Capt. Jeffrey Stanback, Maj. Albert Sweet, Capt. L. Tuite, Capt. H. E. Vick, Lt. J. W. Wester, Lt.-Col. C. A. White, Maj. A. R. Springer, Capt. W. C. Williams, Lt. H. G. Wyman.

American Engineering Council

Organization for 1929 of more than a score of committees to work with Congress and the Federal administration in shaping public policies involving engineering operations has been announced by the American Engineering Council. Communications, flood control, safety of dams, water resources, and Government reorganization are among the chief problems to be studied.

At a meeting of the Council's Administrative Board to be held in Washington in October these committees will submit reports reflecting the engineering attitude toward legislation arising at the next session of Congress.

D. Robert Yarnall of Philadelphia is chairman of the Public Affairs Committee. Public questions affecting engineers generally will come before this Committee, other members of which have been chosen as follows:

J. L. Hamilton, St. Louis; John Lyle Harrington, Kansas City, Mo.; H. A. Kidder, New York City; W. S. Lee, Charlotte, N. C.; R. C. Marshall, Jr., Chicago; Charles Penrose, Philadelphia; R. F. Schuchardt, Chicago; C. E. Skinner, East Pittsburgh, Pa.; Max Toltz, St. Paul, Minn.; Edwin F. Wendt, Washington, D. C.

A new committee on Communications has been named to study proposed legislation for Federal supervision of such means of communication as radio, telephone, and telegraph. This Committee, headed by Edwin F. Wendt of Washington, will study fundamental questions raised by the Watson and Couzens bills. Other members are: O. H. Caldwell, New York, Federal Radio Commissioner; Dean Dexter S. Kimball, Cornell University; Frank A. Scott, Cleveland; Charles B. Hawley, Washington, D. C.

Gardner S. Williams of Ann Arbor, Mich., is chairman of a Committee on Flood Control. Mr. Williams also heads Committees on Government Reorganization and the Safety of Dams.

Chairmen of other Committees of the Council include:

Power—Farley Osgood, New York; Reforestation—William Boss, University of Minnesota; Street and Highway Safety—M. M. Fowler, Chicago; Recent Economic Changes—Dean Dexter S. Kimball, Cornell University; Engineering and Allied Technical Professions—H. C. Morris, Washington; Regional Activities, and Membership and Representation—O. H. Koch, Dallas, Texas; Program of Research—Dr. Harrison E. Howe, Washington; Man-Hour Information and Constitution and By-Laws—L. P. Alford, New York; Patents—Edwin J. Prindle, New York; National Hydraulic Laboratory—Farley Osgood, New York; Washington-Potomac Canal—D. H. Sawyer, Washington; Finance—John H. Finney, Washington; Representation—A. W. Berresford, New York.

Book Review

Public Health Law. By James A. Tobey. 1926. Baltimore. Williams & Wilkins. Pp. 303. Price $4.50.

Most public works officials are concerned in some way with the law. They may be engaged in the administration of statutes, or they may be undertaking activities in which circumstances may make them liable to others for injuries unintentionally inflicted. For all such persons this book will be of distinct value, as it sets forth the fundamental principles of law as they apply to an important class of public servants. The material is also of importance to those who are engaged in private occupations of a public works character, especially in its treatment of the legal phases of nuisances, of liability, and of legislative drafting.

The fifteen chapters of this book, which is the only modern treatise on sanitary law, take up such important matters as the sources of law, the police power, state and local health departments, special powers of health authorities, control of communicable diseases, nuisances and sanitation, social and mental hygiene, health officers, liability, legislation, and law enforcement. The author has the unique distinction to be a member of the bar as well as a sanitarian of note, who has made many contributions to public health law, including a widely quoted article on the liability for water-borne typhoid which appeared in *Public Works*.

The book contains a valuable table of cases, as well as other useful appendices. There is a foreword by Dr. Charles V. Chapin. This volume deserves a place in the library of any public works official who wishes to know something about law.

Civil Service

Physicist—The United States Civil Service Commission announces examinations for: Physicist, $3,800 a year; associate physicist, $3,200 a year; assistant physicist, $2,600 a year. Applications for the above-named positions must be on file with the Civil Service Commission, Washington, D. C., not later than August 14. The examinations are to fill vacancies in the Bureau of Standards and Bureau of Mines, Department of Commerce, and under the National Advisory Committee for Aeronautics, and in positions requiring similar qualifications in other branches of the service.

The optional subjects are (1) heat, (2) electricity, (3) mechanics, (4) optics, (5) radio, (6) physical metallurgy, (7) thermodynamics, and aerodynamics, or (8) any specialized work in the field of physics not included in any of the above. Competitors will not be required to report for examination at any place, but will be rated on their education and experience, and writings to be filed by the applicant.

Information—Full information may be obtained from the United States Civil Service Commission at Washington, D. C., or the secretary of the United States Civil Service Board of Examiners at the post office or custom house in any city.

Personals

W. N. Durham has been appointed city manager of Amarillo, Tex.

Harry Rutter has been chosen city manager of Gastonia, N. C., to succeed the late David L. Struthers.

R. P. Reagon, formerly city manager of Grandfield, Oklahoma, has been appointed city manager of Burkburnett, Tex.

A change in the organization in the Foote Co., Inc., of Nunda, N. Y., has been announced. F. L. Dake, formerly secretary-treasurer of the corporation, becomes president and secretary, and R. E. Brooks becomes vice-president and treasurer. C. E. Foote and H. M. Foote, formerly president and vice-president of the company, are retiring.

R. W. Rigsby, for eight years city manager of Durham, North Carolina, has resigned to become the first city manager of Charlotte, N. C.

G. O. Arnold, an engineer of the Florida State Highway Commission, has been appointed city manager of Bozeman, to succeed S. A. Mendenhall, resigned.

George C. Gensheimer, for many years with the water works department of the city of Erie, Pa., and widely known in water works circles, died June 28.

Frank T. Fay, sales manager of the Asphalt Department of the Standard Oil Company of New York, Boston Division, died at Boston, on Sunday, May 5. Mr. Fay was 70 years old. Graduated from the Worcester Polytechnic Institute, in 1878, he had been with the Standard Oil Company ever since, making a notable record for fifty years in the service of the company. He was a pioneer in the road oil and asphalt business in New England. He had been in charge of the department which he headed throughout its existence.

John D. Owens, one of the founders of The Osgood Company and father of C. A. Owens, president of that company, died June 24 at the age of 72 following an illness of two weeks. At the time of his death, Mr. Owens was chairman of the board of The Osgood Company and serving in advisory capacities with all of the Owens interests.

Trade Publications

Materials Are Important.—An inesting pamphlet of the above title states the standard sizes of welding wires and tells the particular type of wire to use for various welding jobs such as: structural shapes, bars, pipe, rail ends, etc. Fabricators, welders, etc., will find the pamphlet valuable for their files. Copies may be obtained, without charge, by addressing a request to the Page Steel & Wire Company, Bridgeport, Conn.

Drill Sharpeners—The Sullivan Machinery Company has just published a new bulletin on its light model drill steel sharpener, Class "C," which has proved its desirability for work on hammer drill bits and shanks for the lighter drills, utilizing 7/8-inch to 1-inch steel. It is also effective for making pick and chisel point bits for concrete breakers, and other similar tools. The "C" sharpener weighs only 1,100 lbs., placing it in the portable class for the contractor.

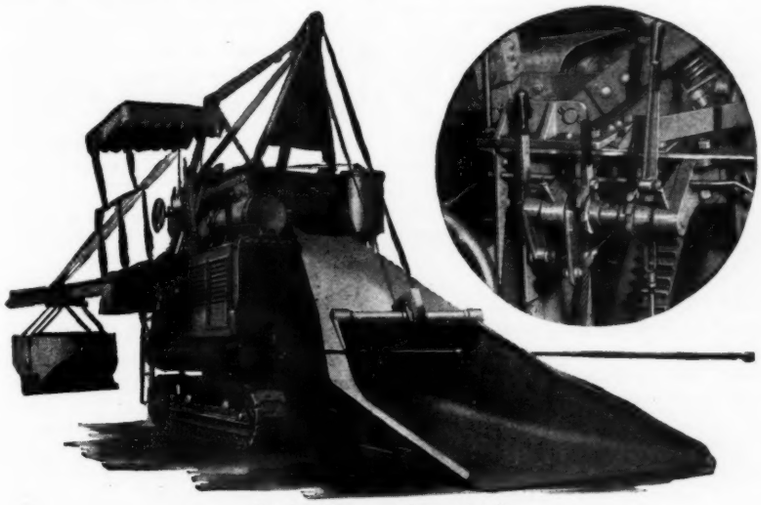
Blowers.—The P. H. & F. M. Roots Company, Connersville, Indiana, has just issued a new bulletin, Number 22-B1 on Low Pressure Type Rotary Positive Blowers. The bulletin covers the new Roots modernized Blowers equipped with Timken, SKF and Hyatt Bearings; included also is another new bulletin, 10-B1, "Covers Industry Like a Blanket," and a book on "Engineering Tables," all bound in a loose-leaf cover. This combination of three pieces contains much general engineering data which proves valuable for reference and is sent on request.

Engineering and Construction Equipment

New Machinery, Apparatus, Materials and Methods and Recent Installations.

Foote Announces New Power Operator

A new system of paver control which is intended to make possible the advantages of automatic operation and at the same time overcome the disadvantages which arise from a rigidly fixed operating cycle by enabling the operator to coordinate the mixing cycle with other operations whenever necessary is a feature of the 1929 Multi-Foote paver.



Foote "Power Operator"

The new system of control which is known as the "Power Operator" enables the operator to have mechanical operation when he wants it thereby frequently reducing the operating cycle and at the same time enabling him to take advantage of conditions caused by auxiliary equipment being late or early in coordination with the mixer.

The control levers are grouped and arranged within easy reach on the high operating platform. The Power Operator is mounted about waist high, left center of the platform, and consists of two small levers. The shaft on which the levers are mounted is so geared that it oscillates back and forth one-fourth of a revolution. It is fitted with two cams, one for each lever so that when either of the small operating levers are moved they engage in one of the notches on the cam and the movement of the cam itself actuates the clutch.

This arrangement gives extremely easy operation of the controls and relieves the operator of practically all effort, the levers being so light "on the trigger" that they can be actuated with the little finger. The light operation aids materially in speeding up operation of the controls and makes the throwing in and out of the clutches almost instantaneous.

Another feature of the Power Operator is the fact that the operator has full control of the mixing cycle at any point. For example, the skip can be stopped when it is half way up and raised or lowered from any position and at any time the operator desires.

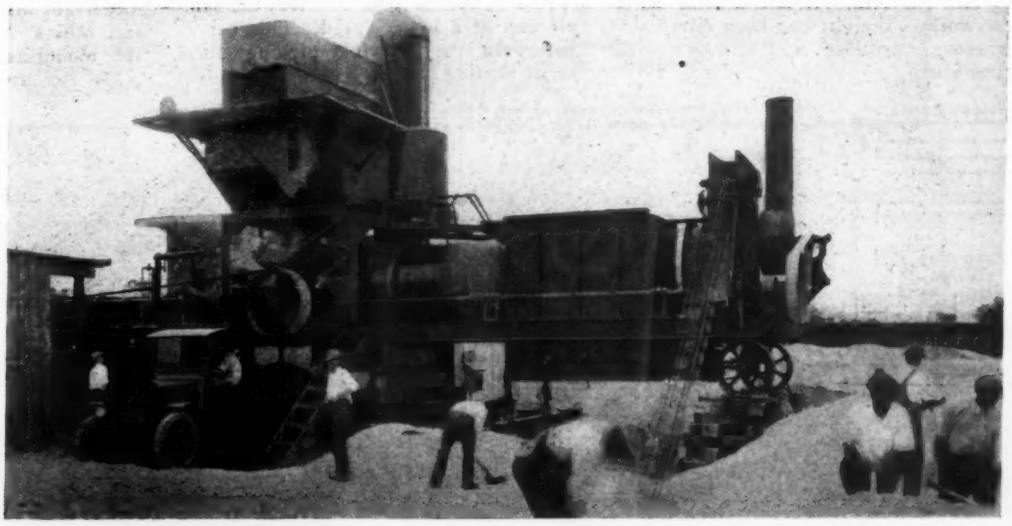
New Cummer Two-Fire Asphalt Plant

The F. D. Cummer & Son Co., of Cleveland, Ohio, manufacture their new two-fire asphalt plant in four sizes with capacities of 400, 1,000, 1,600 and 2,200 square yards of 2-inch sheet asphalt topping per day. Portable plants with the 2-fire device are also available.

The 2-fire dryer is claimed to have greater capacity; longer life because of the lower temperatures used; better fuel economy; and accurate control of the dried and heated sand temperatures. The sand and stone is subjected to dry heat at the temperature best suited to its condition at each stage of the drying and heating process.

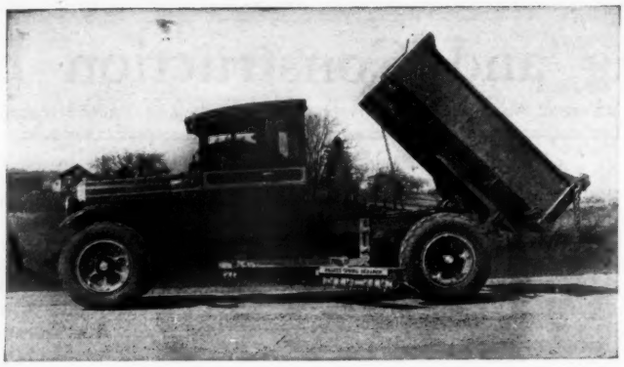
In operation, the wet sand and stone is fed through a feed spout in this breeching. As the wet material enters the drying cylinder it is met by a blast of dry hot air from the first hood and as it travels towards the discharge end, it is met by fresh blasts of dry hot air from each succeeding hood. These hoods are placed at intervals of about 18 inches. Because of the fact that the material entering the drying cylinder is wet and cold, the heated air from the first hood quickly becomes saturated with moisture and loses its heat and is drawn out by the fan. The heated air from the following hoods loses its heat more slowly and stays in the cylinder a correspondingly longer time as the drying material works towards the discharge end; constantly becoming warmer and drier.

The drying cylinder is designed so that the sand and stone will be warm and almost dry before it passes the last



New Cummer Two-Fire Asphalt Plant

heat inlet, and the material then passes rearward into the dry heat from the rear oil combustion chamber. By regulating the supply of oil to this combustion chamber, the dried material can be discharged at any desired temperature from 200° Fahr. to 500° Fahr. The temperature of the sand and stone as it is discharged from the dryer is registered by a thermometer on the mixer platform in plain view of the mixer man, and as he is responsible for the temperature of the asphalt mixture, he also has control of the oil supply to the rear combustion chamber, so that he can at all times have the sand and stone discharged into the storage bin over the mixer at the proper temperatures.



Dump Truck Used as Scraper

The road maintenance unit shown above is a Dodge 3-ton chassis with a Wood body and hydraulic hoist. A Willett 10-ft. spring scraper is the equipment shown underneath the chassis. The unit is particularly useful in road maintenance for carrying away surplus material and redistributing it along the highway. It is in use in Wyoming Township, Kent County, Michigan.

Bucyrus-Erie Crane, Shovel, and Dragline

The Bucyrus-Erie Co., South Milwaukee, Wisc., has brought out the "1020" one-half-yard crane. This new model which is the smallest in the complete Bucyrus-Erie line, is standard equipped with a 48 h. p. gasoline motor, making it the most powerful crane and shovel of its size. This extra margin of power enables the "1020" to handle harder excavation and heavier crane work, and makes faster operation possible throughout the entire operating cycle. Many features, not usually found in a machine of this size and type, have been incorporated, such as a one-piece steel truck frame and turntable, enclosed gears running in oil, and antifriction bearings on all high speed shafts.

To insure easy mobility, the weight of the Bucyrus-Erie "1020" has been kept as low as is consistent with the necessary strength to handle the hardest work. Weight has been eliminated wherever possible without sacrificing strength.

In design, the "1020" is practically a smaller duplication of the Bucyrus-Erie "1030" ¾-cubic-yard gasoline shovel, crane and dragline. The only difference between the "1020" and "1030" is that of size, weight and price.

The "1020" can be used as a crane, dragline, shovel or drag-shovel. Convertibilty has been planned for in designing the machine, and it can be changed over easily and quickly from one type to another, as required. It is also furnished as an electric machine where electric power is available.

Sewage Samplitt

Max B. Miller & Co., N. Y., have developed the "Samplitt," which is a device intended to facilitate the taking of proportional and representative samples of sewage.

It is intended to be bolted to the concrete wall of the sewage flume or channel and is operated entirely by the flow of the sewage.

The paddle wheel is revolved by the sewage stream and in turn through a special reduction gear revolves the sample cup at a lower speed. This cup is shown in the drawing picking up a small sample and as the arm revolves this cup is lifted out of the stream. When the arm is at an angle of about 45 degrees above the horizontal, the cup tips over and dumps the sample which runs down the trough shaped arm and is led by means of the second trough into the sample container.

Since the paddle wheel revolves at a speed always proportional to that of the sewage, and the cup picks up a quantity varying with the depth of the stream, it is clear that the sample taken will always be proportional to the quantity of sewage flowing, hence assuring accurate sampling notwithstanding variations in rate of flow and depth of stream.

All passages for the flow of the sample are open troughs which can not get plugged up with solids and are easily cleaned.

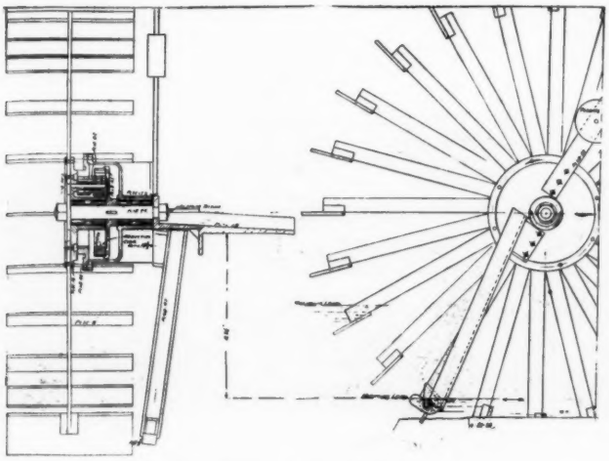
The gears and bearings are totally enclosed in a grease tight chamber.

Joslin Weatherproof Street Signs

The A. D. Joslin Manufacturing Co., Manistee, Mich., make a variety of street signs including the standard 4-way sign. Two sizes of these signs are available in all types of assemblies irregular or standard. The smaller size has a 2½-inch letter; the large size has a 3½-inch letter. Highly polished embossed aluminum letters assure maximum readability from any angle and at all hours of the day or night. The background of black Du Pont Duco makes this an unusually legible combination.

No bolts or screws are used, the entire assembly being locked by one nut at the lower end of the center post.

Other types of Joslin Street Sign assemblies are available, including: 4 way box type; 4 way right angle; two way right angle; two way single unit; and others. Various types of brackets for mounting on light and telegraph poles, etc., are also furnished.



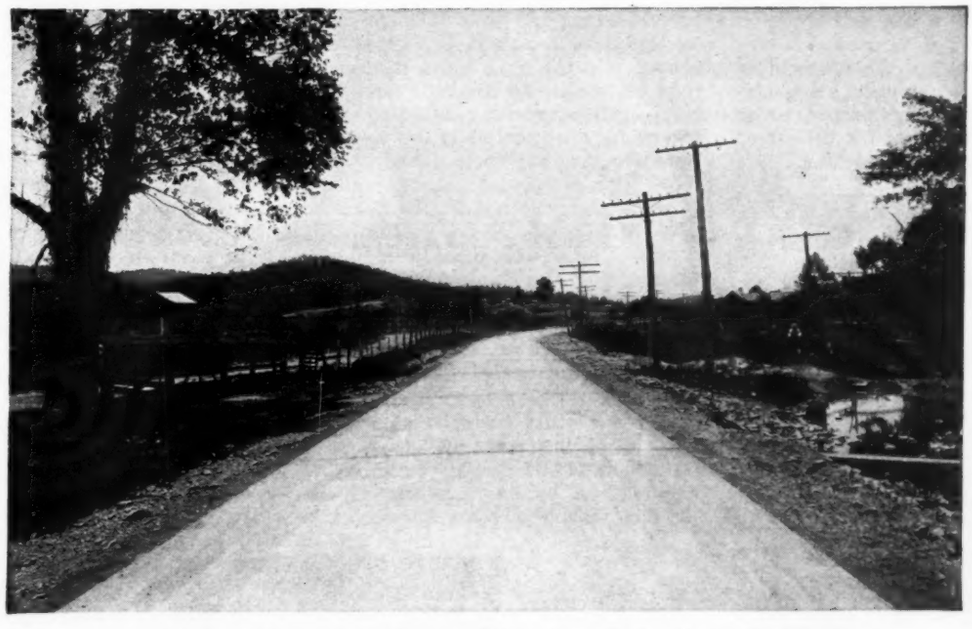
Sewage "Samplitt"

Bucyrus Erie "1020"

Mile after mile—

[of unwrinkled concrete,]

through the heart of TENNESSEE



A section of the concrete Dayton Pike, through Southern Tennessee. Carey Elastite Expansion Joint, installed transversely at frequent intervals, keeps the road smooth and prolongs its life.

A revelation to motorists, the inviting expanse of white concrete that ribbons through Hamilton County, in Southern Tennessee. One of the finest, smoothest roads in the South, because "shock absorbers" are *bonded right into the concrete.*

Carey Elastite Expansion Joint! It compresses readily under pressure—protects concrete against seasonal strains and prolongs its life. The water-tight, frost-tight sandwich joint, extensively used and recommended by leading engineers and contractors in every State in the Union. Manufactured by a company who has been in business over fifty years—pioneer makers of expansion joints. Write for particulars about modern installation methods.

Carey Elastite EXPANSION JOINT

THE PHILIP CAREY COMPANY, *Lockland,* CINCINNATI, OHIO

Lakewood "Duo-Rail" Form

The Lakewood Engineering Co., Cleveland, O., has brought out the Lakewood "Duo-Rail" form which, it is claimed is of material value to the contractor and engineer in getting a smoother riding surface on concrete roads.

The novel construction of this form lies in the fact that the load of the finishing machine is carried over the center of the base of the form by means of an auxiliary rail, thus materially adding to the stability and bearing value of the form.

These rails are held in place on the stake pockets by dowel pins fastened thereto, fitting into the holes in the stake pockets, and approximately 100 feet of the auxiliary-rail is all that is used on each side of the road for finishing machine operation, being carried forward as the work progresses.

The base of this form is 8 inches wide, and, due to this additional width and central loading, offers almost three times the bearing value of the present standard 6-inch base form, with the load carried on the inside web.

The auxiliary rail is used only for the finishing machine, the floatbridges and other lighter equipment being carried as usual on the form proper, which also acts as the template for the screed member of the finishing machine.

A New Chlorine Colorimeter

The LaMotte Chlorine Colorimeter, for determining free or residual chlorine in drinking water, has recently been developed by the LaMotte Chemical Products Co., Baltimore, Md. The set consists of 8 permanent chlorine color standards in LaMotte "Sealed Nessler tubes" with polished tops and bottoms, representing 0.02, 0.04, 0.06, 0.08, 0.10, 0.15, 0.20 and 0.30 parts per million of chlorine respectively;

LaMotte Chlorine Colorimeter

three open Nessler tubes for the test sample; a 50 cc. bottle of Ortho-Tolidine reagent with 0.5 cc. pipette and nipple; and a LaMotte Colorimeter for Nessler tube comparison. This equipment is compactly arranged in a polished wooden case with a handle for carrying.

Previously difficulty has been experienced with standards kept in open Nessler tubes, due to contamination from cork and rubber stoppers, and both contamination and loss of material if the solutions are kept in bottles and poured into the tubes when determinations are made. To eliminate these difficulties, all standards, including those for color, nitrogen, chlorine, iron, nitrate, etc., are put up in closed Nessler tubes with polished tops and bottoms, as recommended by F. R. Georgia (J.A.W.W. Asso., May 1926). The standard tubes are filled through side arms which are then sealed off, preserving the standards from contamination of any kind. The special colorimeter must be used in making determinations with these sealed standards.

In making the determination, one of the open Nessler tubes is filled to the mark (50 cc.) with the water to be tested, 0.5 cc. of the Ortho-tolidine reagent added by means of the pipette, the tube shaken to ensure thorough mixing, and placed in the middle hole of the colorimeter. Two consecutive color standards, for example, those representing 0.04 and 0.06 p.p.m. are then placed in the remaining two holes on either side of the test sample. The tops of the tubes are held toward a window or other source of daylight, and the standards changed if necessary, until the color of the reflection of the test sample in the mirror either matches that of the reflection of one of the standards or lies between the two. If an exact match is obtained the chlorine concentration in parts per million is read off directly from the standard with which the match is obtained. If the color lies between those of the standards on either side, the reading is taken as the average of the two. Thus if it lies between 0.04 and 0.06, it is taken as 0.05 p.p.m.

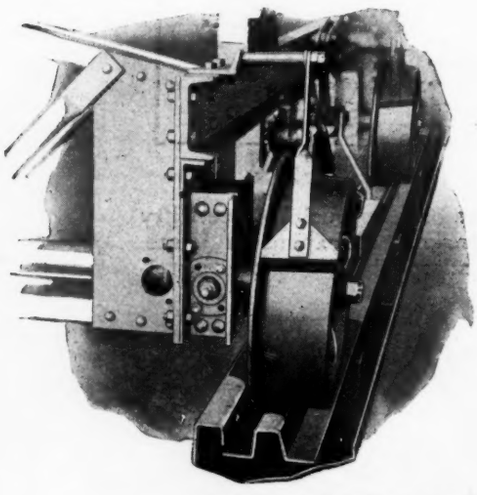
This set is also supplied with permanent standards and reagents for determining nitrogen, nitrates, nitrites, total iron, manganese, etc.

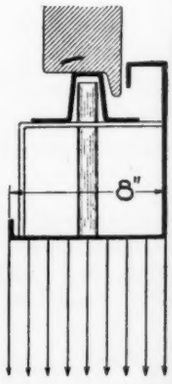
The new principle of making determinations by matching the reflection in the mirror, instead of by looking down through the tubes, makes the readings much more simple and accurate.

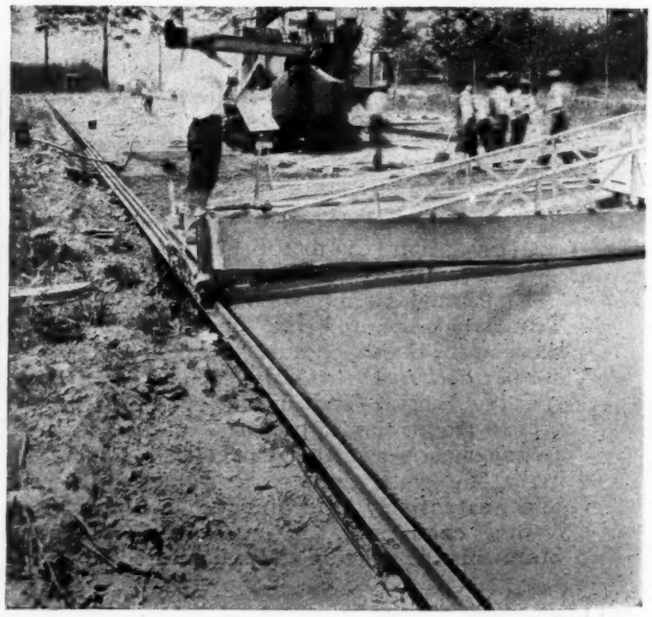
New Holder for Welding Electrodes

As a supplement to its line of electric arc welding equipment, the General Electric Company announces a clamp type electrode holder. This device has jaws of heavy copper alloy, notched to hold firmly any size of electrode wire from 1/16 to 1/4-inch in diameter, in any position.

A molded compound handle protects the operator from heat and from contact with current-carrying parts. The holder is designed for use with currents up to 300 amperes. It may be obtained, if desired, assembled with five feet of extra-flexible cable and terminal.







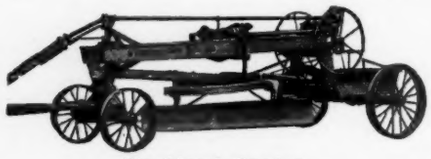
Lakewood Duo-Rail Form

Above: Close-up of form. Center: Figure showing even distribution of weight with this form. Right: In use in concrete road construction.

Stockland Road Grader

Foote Bros. Gear & Machine, Co., Chicago, Ill., manufacture the Stockland road grader which has been designed with an unusually low center of gravity, yet with plenty of road clearance. This feature is of considerable value, especially in sidehill work.

There are other design features claimed for the Stockland Grader that are worthy of consideration in road building. These include the cut, lift, roll, curved blade, proper location of blade, extra long wheelbase, three-point suspension, fewer working parts and heavy frame construction.



Stockland Grader

New Erie Multi-Power Clamshell Bucket

The Erie Steel Construction Company has designed a powerful digging bucket that can be adjusted for the kind of material being dug. The new bucket is called the multi-power, from its working action, which is a combination of the multiple rope and lever arm principles. The multiple rope principle gives power, but slows up the action of the bucket. The lever arm principle gives speed as well as power.

This new bucket can be rigged up with 2, 3, 4, 5, or 6 parts of line. In combining the two principles it was possible to design a bucket requiring considerable less head room, with less line to overhaul, which speeds up operation of the bucket.

The scoops are oversize with but very little added bucket weight. Thus more material can be handled per day with little added power consumption. Counterweights in 100 pound units can be added by one man. They are attached to the buckets by two bolts and can be put on or taken off in but a few minutes.

In addition to these major features there are others which are very important. The stops are improved, relocated and longer—so designed to add reinforcement to the power arm. The main bearing is wider and will take the shock of digging more smoothly and eliminate excessive wear.

All ropes end in wedge and socket. Roller bearings can be furnished in the power arm sheaves at no extra cost. Stellite can be applied to the lips at a slight additional cost. Teeth are of the self-bearing chisel point type and pull the bucket down into the material while closing. Sheaves are of steel and are kept clean by special sheave cleaners. Large bearings keep the parts in alignment. There are heavy down thrust lugs on the bucket scoops to relieve the rivets. The down thrust is actually on the edge of the bucket—thus forcing the scoops into the materials while closing instead of lifting out. Lubrication is by the Alemite System, and a grease gun is furnished with each bucket.

Newaygo Line Markers

The Newaygo Engineering Co., Newaygo, Mich., manufactures a line marker for the quick and economical marking of street crossings, intersections and parking places. This machine differs from other machines as there are no spray nozzles, pumps, valves and hose to become clogged and get out of order. The paint is held at a fixed level in the reservoir in front of the paint tank by vacuum. From here the paint is picked up by an idler wheel which dips into it and spreads it on the marking wheel. The marking wheel, in turn, rolls the paint on the street surface.

The amount of paint carried on to the marker wheel is governed by a thumb nut which applies pressure on the idler wheel, causing a wringing action and squeezing off the excess paint which flows back into the reservoir.

The marker wheel is made of cast iron and is about four inches wide. Heavy wool felt is applied around this wheel. Over the felt a heavy rubber band is stretched.

The felt cushion is thus protected and the paint can not get to it; it will not fill up with paint pigment or harden and lose its cushiony effect. Over the outside of the rubber band is laced a heavy felt cloth which takes the paint from the idler wheel and delivers it onto the street surface.

The Newaygo Line Marker can be taken apart for cleaning purposes in five minutes—and it can be put together again just as quickly.

One man can lift it in and out of a car. The shipping weight, crated, is only 100 pounds. The handles are of wood and can be raised or lowered to meet the convenience of the operator.

It will operate with any kind of paint and even, it is claimed, will operate satisfactorily with lacquer.

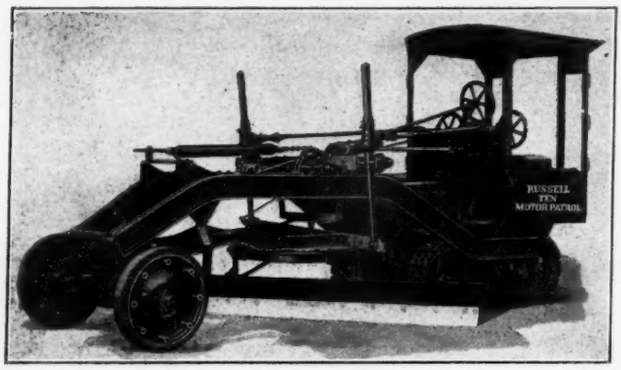
"Caterpillar" Ten and Fifteen Motor Patrols

The Caterpillar Tractor Co., San Leandio, Calif., has brought out the new Ten and Fifteen Motor Patrols.

Newaygo Line Marker

New Erie Clamshell

Those are simpler in construction. Many wearing parts have been eliminated. The blade lift is more powerful. The entire mechanism is easily controlled from the driver's seat by means of four easy turning wheels. Many older models had as many as fifteen controls.



Caterpillar-Russell Ten Motor Patrol

The new features of the Ten and Fifteen motor patrols are:

1. Blade-Lift Mechanism—The lifting mechanism consists of a machine-cut round steel screw, which is connected to the circle crossbar by a large ball and socket. There is a take-up for the ball bearings which take both the up and down thrust. The entire screw and gear mechanism is enclosed in dustproof housing. The advantages are: Larger wearing surface, simplicity, greater leverage, wearing parts reduced, lessened danger of breakage, greater rigidity, weight off tractor, far easier operation.

2. Operating controls—Four easy turning wheels, squarely in front of the operator, give complete command of the machine at all times.

3. Gear Box—By merely pulling out or pushing in the steel plug and wheel, gears are shifted to operate the side shift and scarifier from the same wheel.

4. Draft Connection on Ten—This is a large wearing surface ball and socket which eliminates play, yet gives utmost freedom to pivot in any direction. The Fifteen connection is the same as the Twenty.

5. Tractor Connection—The tractor and grader frame connection is mounted in self-aligning bearings with the trunion shaft centrally located on the tracks. This mechanism gives free movement without binding or bending strain upon either tracks or grader frame.

A Tank Body for Hauling Wet Concrete

The Portland Concrete Machine Co., 53 West Jackson Boulevard, Chicago, Ill., manufacture a tank body for the efficient and satisfactory handling of wet concrete from the central mixing plant to the job.

With this type of body the concrete is discharged into the top of the tank through a filling gate, which, after the load has been received, is closed with a powerful lever lock, hermetically sealing the contents in the shell. The tank is rotated during delivery by means of a separate power plant attached to the front end of the tank, furnishing power for rotation of the drum independent of the truck motor. A special engine throttle governor is provided so that the speed of rotation can be changed at will by the driver, using a more rapid rotation for short hauls, and a slower rate of rotation for long hauls.

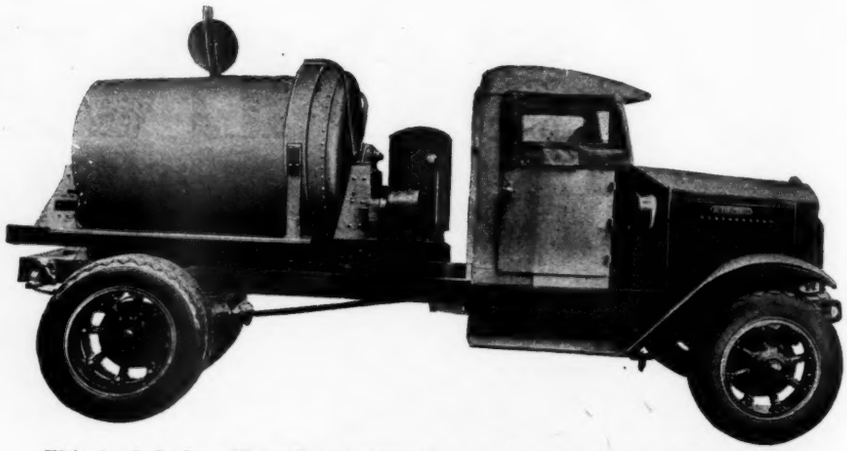
The use of separate power plant does away with the problems of transmission of power from the truck motor and makes possible a rigid construction which is low in upkeep cost.

The tank is provided with internal vanes, one set being so inclined as to direct the material to the front end of the tank, and the other set to guide and direct the material to the rear end. Aided by these vanes and the centrifugal action of rotation the entire mass of material is kept in an even state of consistency throughout the entire haul regardless of distance or time.

The tank is equally effective for handling dry batches from a batching plant and mixing en route, or for the haulage of wet mixed concrete from a central mixing plant.

The tank is a complete unit which is provided with suitable connections for attaching to any standard truck chassis of suitable length and carrying capacity and is adaptable for use with any of the standard truck hoists. It takes only a few minutes to make a change of body so that the tank can be used interchangeably with any other type of body, thus increasing the usefulness of the truck. It can be mounted on a new or old truck body and can be used interchangeably on trucks of the same model and type, giving an unusual degree of flexibility.

The contents, being hermetically sealed during delivery, are protected against weather conditions, and the rotation prevents any setting or hardening, giving the increased strength advantage of remixed concrete. It insures delivery of the material in the same quantity, the same quality, without evaporation or loss of water and without deterioration or change in the character of the concrete. It is particularly efficient for long hauls or for use under dense traffic conditions where delays will be encountered. It meets every requirement of engineering practice.



This tank body will haul wet concrete or mix concrete en route to job

A New Water Control for Foote Pavers

To meet the increasingly rigid requirements of highway departments for accurate water measurements on paving concrete, engineers of the Foote Company, Inc., of Nunda, N. Y., manufacturer of Multi-Foote pavers, have developed a water tank construction on an entirely new principle which effects an exactly accurate control of water to the smallest fraction of a gallon under all conditions, and which combines several other important advantages.

The new tank is of the vertical cylindrical type with a capacity of 46 gallons and can be set so that it measures automatically any desired quantity of water either in pounds or gallons by a simple turn of an adjusting crank. The tank fills itself automatically and signals the operator when it is full, the control system being arranged so that the supply valve through which the tank is filled always closes in advance of the discharge valve which connects to the mixer drum through a 3½-inch line, and which permits quick discharge of water. Also, the discharge valve closes automatically before the supply valve can be opened thus eliminating all possibility of putting into the drum more or less water than is needed.

The tank contains a piston in the head of which is a simple automatic valve which permits the air to escape when water enters the portion of the tank underneath the piston. The piston is adjustable to a graduated scale so that it can be set to measure any desired quantity of water in either gallons or pounds. When the portion of the cylinder below the piston is completely filled with water the air valve in the piston head closes and the resulting pressure automatically closes the water supply valve before more than 5 pounds pressure has been built up on the tank.

Some of the special advantages claimed for this new tank are as follows:

1. The tank is completely drained at each operation.
2. Tilting of the tank due to conditions of grade do not affect the measurement.

Baker Speed "V" Plow at Work

3. The pressure on the tank never exceeds five pounds regardless of the pressure on the supply line.
4. The supply valve is always closed before the discharge valve opens and vice versa, preventing by-passing of water during the valve shifting operation.
5. Automatic closing of the supply valve and signalling of the operator when the tank is full.
6. Ease and fine accuracy of adjustment either in pounds or fractions of a gallon.
7. Low clearance for shipping or moving under low overhead obstructions without removing the tank from paver.
8. Simplicity of tank construction and valve operation.
9. Excessive air pocketed in supply line cannot pocket in tank and interfere with accurate measurement.
10. Positive protection against any possibility of excessive pressure by special relief valve.

Baker Speed "V" Plow No. 11

Unusual success has been reported with Baker snow plows with motor trucks during the past winter. The plows worked at 30 miles per hour or better, throwing the snow completely away from the roads. These plows are made in four models—two sizes each of 2-way "V" type plows and one-way trip blade type for any motor truck.

The complete line of Baker snow plows consist of a large number of trip-blade snow plows—both one-way and reversible types, all equipped with Baker patent tripping blades, exclusive features of Baker snow plows.

Tractor snow plows—hydraulic and mechanical lifts—are also made for leading tractors for ordinary snow removal up to the heaviest plows for bucking the deepest drifts.

New Proportioning, Mixing and Weighing Unit

The T. L. Smith Company of Milwaukee, builders of Smith mixers and pavers, announces the development of a new mixer attachment that enables contractors and owners of commercial concrete plants to meet the most stringent specifications imposed by engineers.

The new device, known as the Smith Weight-Mix, when applied to a standard Smith mixer and batchhopper, forms a complete self-contained concrete manufacturing unit. It is stated by the manufacturers that the new equipment is designed to proportion accurately all materials by weight and then thoroughly mix them into concrete.

Only one man is required to handle both proportioning and mixing operations. The controls are centralized on a platform which is so located that the operator has a full view of the entire plant.

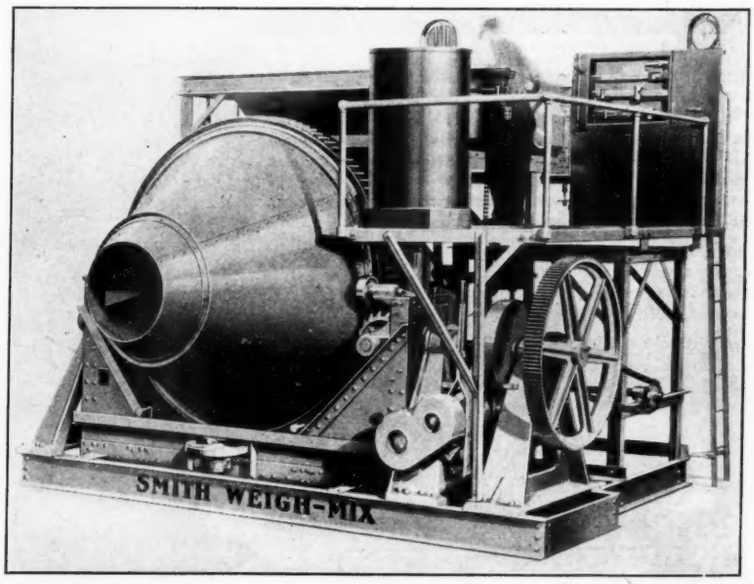
The scale has a separate beam for weighing the coarse and fine aggregate as well as the cement. An auxiliary scale weighs the water. The scales can be locked by the inspector and the operator need only watch the dial pointer to know when the predetermined amount of material has been weighed.

An added feature is an automatic shaking device which completely cleans the hopper and allows the scale to return to balance. The speed of emptying the hopper is also considerably increased by the shaker. At no time while the hopper is vibrating does it come into contact with the weighing mechanism.

It is claimed that the Weigh-Mix forms an ideal unit for central mixing plants. There is a saving effected of from 6 to 10 feet in height compared to the ordinary plant where overhead weighing devices are used. A' smaller plant investment is therefore required, and the cost of conveying material to the storage bins considerably decreased. The complete outfit, which is compactly built and easily portable, has proven unusually successful in operation.

The new Smith Weigh-Mix follows the same design as the Koehring Weigh-Mix. It can be applied to any Smith Mixer now in the field. To those interested the T. L. Smith Company will be glad to send complete descriptive information.

Federal T-20 Roadbuilder with Wood M-4 Body has short turning radius and speedy dumping action



New Smith Weighing and Mixing Unit Proportions All Materials by Weight and Then Mixes Them

"Hunt Process" Assists in *Remarkable Run*

Central mixing plant with 20-sack batch mixer. At the right is shown the application of the "Hunt Process" on hexagonal type pavements. Operator standing on seven-day-old concrete.

Contractor- pours 92,067 sq. yds. in 16 days-

AVERAGING 5,754 square yards a day (799 cubic yards), George Oswald, Los Angeles contractor, poured 92,067 square yards of 5-inch concrete paving in 16 eight-hour days—a record made practicable by using the "Hunt Process" cure.

Pavement was laid in a tract within one mile of a central mixing plant containing a 20-sack batch mixer. By using the "Hunt Process," two men alone handled the curing of this tremendous run. Under similar conditions, this established method of curing will help any contractor get similar results.

The "Hunt Process" is an accepted method among progressive contractors throughout the country. It opens the road days earlier—hastens the job's acceptance—gives 8½% stronger concrete and increases resistance to abrasion. Can be used to advantage on any form of concrete work. Write on your letterhead for descriptive booklet.

Mc EVERLAST, INC.

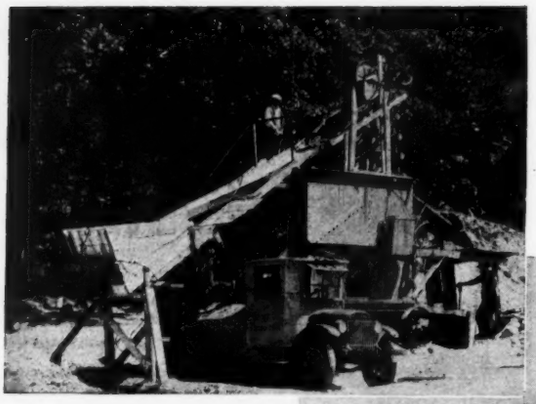
111 West Seventh St. Los Angeles, Calif.

35 E. Wacker Dr. Chicago, Ill.

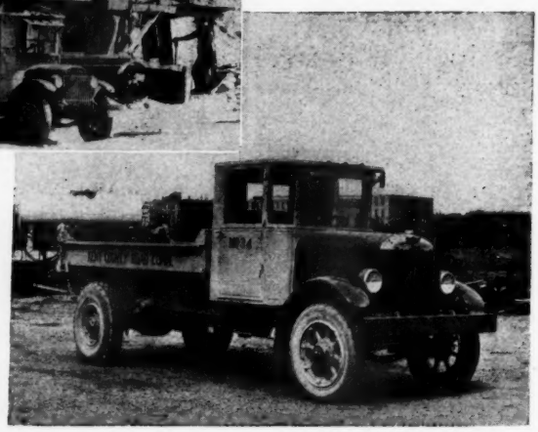
1754 Graybar Bldg. New York, N. Y.

1314 Magnolia Bldg. Dallas, Texas

Offices in Principal Cities



Modern Equipment Builds Modern Roads



A Fleet of 47 Republic motor trucks, most of them 3½-ton, with Wood hoists and 2-yard bodies, is in use in Kent County, Mich.

Industrial Notes

The Foote Company, Inc., of Nunda, N. Y., manufacturers of Multifoote Pavers, have appointed the following new direct factory representatives: Standard Machinery & Equipment Compay, of Spartanburg, South Carolina, for the States of North and South Carolina; R. S. Armstrong & Brother Co., of Atlanta, for the State of Georgia; Southern States Equipment Company, of New Orleans, Louisiana, for the State of Louisiana; Burton Franklin, of Chattanooga, for the State of Tennessee; the C. H. Jones Company, of Salt Lake City, Utah, for the States of Utah and southern Idaho; H. W. Moore Equipment Company, of Denver, Colorado, for the States of Colorado and eastern Wyoming; the Clyde Equipment Company, of Portland, Oregon, for the States of Washington, Oregon and northern Idaho.

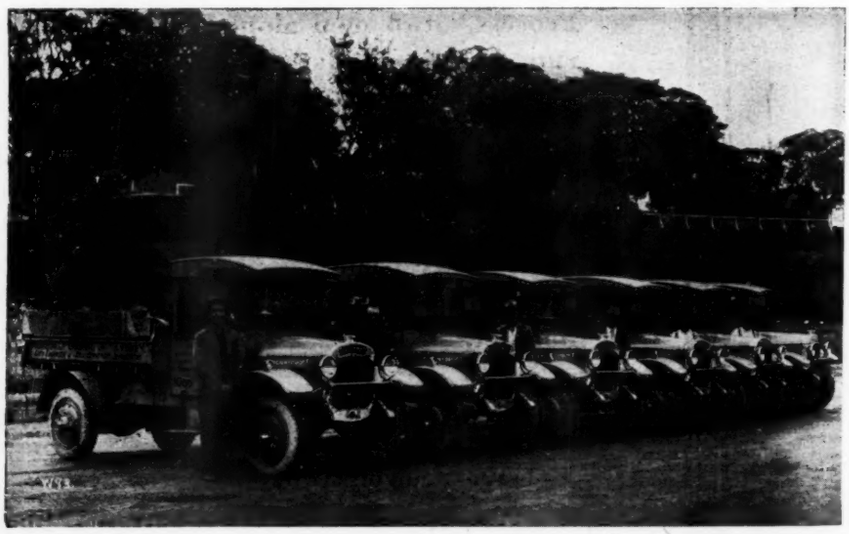
Sixteen more FWD trucks have been ordered by the State Highway Department of Minnesota. That makes eight separate orders placed by the Minnesota State Highway Department and a total fleet of forty FWD's. The trucks are to be Commercial Utility 3½ tonners. The traveling speed will range from 3 miles an hour to 30. They will be equipped with a dual ignition system, fifty gallon gas tanks and pneumatic tires. The trucks are to be used in snow removal work in the winter and are equipped with special snow equipment: two tail lamps with yellow lens; two blue lamps with 8-inch lens placed near the top of the cab, one at center in front and one at center behind; one white flood light for illuminating the right end of the snow plow and wings; one yellow flood light to illuminate the left end of the snow plow. The trucks will be equipped with a sliding door cab, double electric wind shield wiper, rear-view mirror and speedometer. These trucks were ordered through the FWD Sales Company of St. Paul, Minnesota, (14) and M. W. Turner, Duluth (2). The trucks are going to be used for road building and road maintenance, as well as snow removal.

Wallace & Tiernan have just mailed to all sanitary engineers, sewage plant operators and public health officials in the United States and Canada a reprint of the article, "Advancements and Developments in Sewage Chlorination," by Linn H. Enslow, Research Engineer of the Chlorine Institute. This is published in the standard 6x9 size used by Wallace & Tiernan for this type of educational publicity and is a most interesting document for all interested in sewage chlorination to have in their library.

The Union Chain Co., Sandusky, O., has opened sales offices at Third and Plum streets, St. Louis., Mo., in charge of Hugh Scott; and at 1535 Naomi street, Indianapolis, in charge of A. R. Young.

Milton W. Anderson, of Chicago, was re-elected president of the United Tractor and Equipment Corporation, comprising forty prominent makers and distributors of tractors, farm implements and industrial equipmbent, at the annual directors' meeting, held June 19 at Milwaukee. W. B. May, president of W. B. May, Inc., Buffalo, N. Y., was elected vice-president, E. R. Wehr, vice-president of the Wehr Company, Milwaukee was elected secretary-treasurer, and H. T. Enns, Jr., Chicago, assistant secretary-treasurer. Directors were elected at the stockholders' annual meeting in Chicago June 18, as follows: H. C. Merritt, Allis-Chalmers, Walter H. Stiemke, Trackson Co., and E. R. Wehr, all of Milwaukee; Arthur S. Hughes, the Hughes-Keenan Co., Mansfield, Ohio; Dunbar Abston, Dealers' Equipment Co., Memphis, Tenn.; A. W. Logan, Motor Power Equipment Co., St. Paul, Minn.; C. V. Ruble, Universal Equipment Co., Kansas City, Mo.; W. B. May, W. B. May, Inc., Buffalo, N. Y., and Milton W. Anderson.

American Equipment in Use "Down Under"



In Australia, modern equipment is as much appreciated as here. These Thornycroft trucks, equipped with Wood hoists and bodies are owned and operated by the City of Sydney.

New Catalogs

Cold Patch.—The Texas Co., N. Y., has published a 24-page booklet illustrating the many uses for Texaco Cold Patch.

Road Machinery — Austin-Western Road Machinery Co., Chicago, Ill. An illustrated folder describing 12 improved road grader models.

Motor Sweepers.—The Austin-Western Road Machinery Co., Chicago. Catalog No. 8, describing the Austin Motor Pick-up Sweeper.

Diesel Engines—I. P. Morris and De La Vergne, Inc., Philadelphia, Pa. A 40-page illustrated catalog describing De La Vergne Diesel Engines.

10-Foot Road Grader.—The Austin Mammoth Junior 10-foot Leaning Wheel Grader is described in detail in publication 1076 of the Austin-Western Road Machinery Co., Chicago, Ill.

Water Works Valves—I. P. Morris and De La Vergne, Inc., Philadelphia, Pa. A 12-page illustrated catalog describing Larner-Johnson valves for various sorts of water works services.

Buckeye Crane.—An illustrated folder in colors describing the Buckeye Utility Crane, manufactured by the Buckeye Traction Ditcher Co., Findlay, O.

Chlorinators.—The Paradon Mfg. Co., Arlington, N. J., has issued Technical Bulletin No. 21 describing the Paradon Dry Feed Chlorinators, suitable for all purposes of chlorination.

Graders.—The Austin-Western Road Machinery Co., Chicago, Ill., has issued an illustrated folder describing graders.

Trackson Tractor.—The new model L. H. Trackson Full-Crawler for the McCormick-Deering industrial tractor is described in a folder issued by the Trackson Co., Milwaukee, Wisc.

Slackline Cableways.—Page slackline cableways built in various sizes are described in Bulletin 700. Page Engineering Co., 844 Rush street, Chicago, Ill.

Servicised Products.—Catalog No. 12 deals with expansion joints in a rather brief but fairly complete manner, and treats exhaustively of other Servicised Products of later development. Among these are fibrated Asphalt Planking, Industrial Flooring, Rail Filler, Highway Crossing and Protection Course for Waterproofing. Readers interested in waterproofing protection materials for use in connection with concrete construction for any purpose will find data of interest in this catalog.

Building Airports.—The Caterpillar Tractor Co., San Leandro, Calif., has just published an illustrated booklet on building airports. Copies will be sent free on request.

Road Graders.—The Stockland Grader Book, S-100, gives very complete data on road grading equipment Foote Bros. Gear & Machine Co., 111 North Canal St., Chicago.

Cranes.—This covers the crane rental field and gives valuable data on the profits possible through rental and job work. Bulletin 46. Universal Crane Co., Cleveland, O.

Pumps.—Bulletin No. 15, Pomona Pump Co., describes the full line of Pomona turbine pumps. 32 pages, illustrated.

Gravel Equipment.—An 80-page illustrated catalog, exceedingly complete in all regards and containing much data of interest to engineers and contractors, has been published by the Pioneer Gravel Equipment Co., Minneapolis, Minn.

Power Grader.—Specifications and descriptions of Warco models "E" and "ER" power graders have been published in bulletin 2902 by the W. A. Riddell Co., Bucyrus, O.

"Getting on the Air Map with 'Caterpillar,'" profusely illustrated with action pictures, describes the many uses of the tractor in building and maintaining airports better, quicker, cheaper. Caterpillar Tractor Co., San Leandro, Calif. and Peoria, Ill.

World's Largest Clamshell Bucket

A16½-yard clamshell has just been shipped by the G. H. Williams Company of Erie, Pa., to the Donner Steel Company, at Buffalo. As far as known, this is the largest clamshell bucket ever built—at one grab it picks up 10 gross tons of coal.

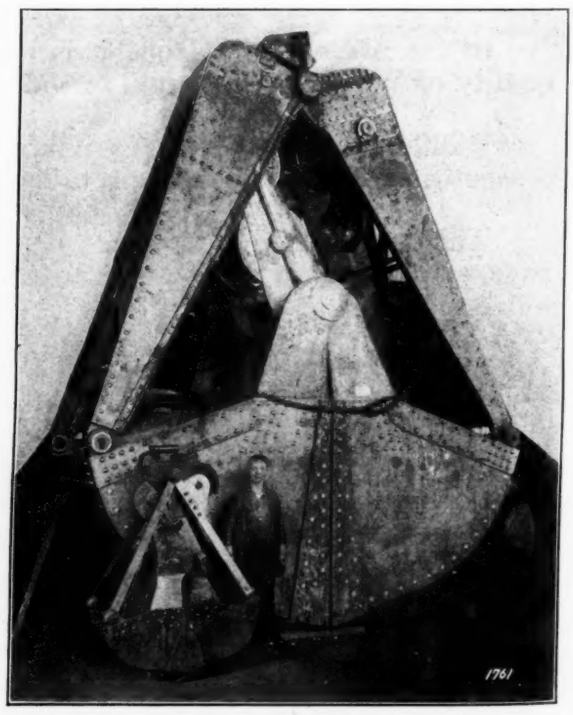
An idea of this bucket's size will be gained from the picture on this page, showing the world's largest bucket alongside one of the small Williams clamshells, the capacity of which is only 3/8-yard, or 10 cubic feet. From the bottom of its scoop to the top of the head, this big coal bucket measures 18 feet 9 inches in height. When this bucket is lowered open, onto a pile of coal, its scoops have a spread of 19 feet. The area covered by the spreading scoops is 133 square feet.

This bucket was designed especially to increase the capacity of a crane already in use on the docks of the Donner Steel Company. In the design, it was necessary for the Williams engineers to conserve every pound of weight possible, to enable the bucket to handle the greatest possible coal tonnage with the power available. Accordingly, this 16½-yard capacity bucket weights only 28,000 pounds, which is very light for a bucket of this size.

In general design, the bucket is of the Williams four-rope type, which gives the operator positive control even on a high bridge crane, where the bucket must be lowered a considerable distance. Smooth, fast operation is always obtainable, the spread of the four lines preventing any twisting or fouling.

The twin-power-arm design of the Williams four-rope bucket also makes important savings in cable expense—due to the prevention of cable twisting, and also the entire elimination of "side leads" of closing cable. The closing line sheaves on each of the twin power arms work always in the one plane, giving a straight line pull. This saves wear on sheaves, flanges and bearings, as well as cable.

Like every other bucket in the Williams line, this four-rope coal handler bucket is built entirely of steel.



World's Largest Clamshell

Unit Construction Costs

State of Rhode Island, Board of Public Roads

Contract No. 2908, F. A. Project No. 46-D, Scituate-Coventry, Hope-Knotty Rd. Bids opened April 3, 1929

Bituminous Macadam—Penetration

(1) Ricci & Ricci Exc. Co., Providence, R. I., $91,456.60; (2) Frank J. Shields, Providence, R. I., $93,193.55; (3) Perini & Ampollini, Plainville, Mass., $94,340.10; (4) John J. McHale, Pawtucket, R. I., $97,788.00; (5) Hagan-Thibodeau Constr., Eden Park, R. I., $102,194.70; (6) Carrigan & Whipple, Providence, R. I., $103,300.50; (7) A. D. Bridge's Sons, Inc., Hazardville, Conn., $104,484.10; (8) Joseph McCormick, East Providence, R. I., $108,614.85; (9) B. Perini & Sons, Inc., Ashland, Mass., $108,956.45.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
10.7 Acres—Clearing and Grubbing	$90.	$100.	$75.	$100.	$200.	$100.	$150.	$100.	$150.
35 Each—Cutting—Removing Trees	10.	10.	10.	10.	5.	10.	20.	10.	10.
50,060 C. Y.—Earth Excavation	.50	.53	.50	.45	.60	.70	.55	.68	.70
2,500 C. Y.—Ledge Excavation	2.00	2.30	3.50	2.00	3.00	3.00	5.00	3.50	3.00
10,899 C. Y.—Gravel Foundation	.95	.95	.90	.90	.90	.80	1.00	.95	1.15
636 L. Ft.—Sub-Drain 12"	2.00	1.75	1.35	2.00	1.50	3.00	1.75	2.00	1.60
906 L. Ft.—Laying 12" Vit. Clay	.70	.75	.60	1.00	1.00	1.00	1.00	1.00	.70
1,476 L. Ft.—Laying 12" C. M. P.	.70	.65	.50	1.00	.75	.75	.60	1.00	.70
142 L. Ft.—Laying 24" C. M. P.	.70	1.50	1.00	2.00	2.00	1.25	1.00	1.00	.80
17 Each—Catch Basins "D"	75.	75.	75.	75.	70.	70.	75.	100.	80.
93 C. Y.—Concrete Masonry	18.	18.	16.	25.	20.	20.	22.	20.	25.
24 S. Y.—Cobble—Gutter (Grouted)	2.00	1.75	2.00	2.00	1.00	1.50	1.50	1.50	1.50
2,270 L. Ft.—Wooden Guard Rail "B"	.45	.48	.50	.65	.45	.50	.50	.50	.60
6,080 Tons Crushed Stone (Trap)	3.00	2,95	3.10	3.25	3.00	3.00	2.95	3.20	3.25
7,550 Tons Crushed Stone Base	2.00	1.90	2.10	2.50	2.20	2.25	2.00	1.95	2.10
2,400 C. Y.—Filler	1.30	1.50	1.50	1.50	2.00	0.90	1.00	1.50	1.50
87,800 Gals. Bituminous Binder	0.04	0.04	0.04	0.04	0.045	0.045	0.04	0.03	0.055
76,210 S. Y. Trimming and Fine Grading	0.025	0.02	0.01	0.04	0.01	0.03	0.05	0.05	0.05
3,500 L. Ft. Stone Edging	0.20	0.30	0.20	0.30	0.20	0.30	0.25	0.30	0.50
125 L. Ft. Concrete Curbing	1.00	1.00	1.00	1.00	1.00	1.00	0.60	2.00	1.50

Construction of Cushman Tunnel No. 2, City of Tacoma, Wash.

1. Youdall Construction Co., San Francisco, Calif., (awarded contract); 2. Utah Construction Co., San Francisco, Calif.; 3. T. E. Connelly, San Francisco, Calif.; 4. Chas. & Geo. K. Thompson, Los Angeles, Calif.

No. Item	Estimated Quantities	1 Unit Price	1 Amount	2 Unit Price	2 Amount	3 Unit Price	3 Amount	4 Unit Price	4 Amount
1. Clearing	21 Acres	350.00	7,350.00	350.00	7 350.00	250.00	5,250.00	253.00	5,313.00
2. Grubbing	10 Acres	375.00	3,750.00	350.00	3 500.00	300.00	3,000.00	380.00	3,800.00
3. Tunnel Excavation	12,800 Lin ft	61.60	788,480.00	58.00	742,400.00	88.00	1,126,400.00	93.50	1,196,800.00
4. Road Grading—Common	22,000 cu. yds.	.25	5,500.00	.40	8,800.00	.60	13,200.00	.45	9,900.00
5. Road Grading—Solid Rock	10 cu. yds.	4.00	40.00	1.40	14.00	2.00	20.00	3.00	30.00
6. Drainage Ditch Exc.—Common	100 cu. yds	2.00	200.00	.60	60.00	1.50	150.00	1.25	125.00
7. Drain. Ditch Exc.—Solid Rock	85 cu. yds	4.00	340 00	2.00	170.00	3.50	297.50	6.30	535.00
8. Surge Tank Exc.—Common	11,500 cu. yds.	2.00	23,000.00	.50	5,750.00	.65	7,475.00	1.00	11,500.00
9. Surge Tank Exc.—Solid Rock	10 cu. yds.	4.00	40.00	2.00	20.00	3.00	30.00	6.25	62.50
10. Common Excavation	13,900 cu. yds.	2.50	34,750 00	.50	6,950.00	.75	10,425.00	1.52	21,128.00
11. Solid Rock Excavation	650 cu. yds.	4.00	2,600.00	1.40	910.00	1.65	1,072.50	2.50	1,625.00
12. Overhaul for Roads	1,000 cu. yds.	.04	40.00	.03	30.00	.04	40.00	.05	50.00
13. Gravel Surf. —1 mile Haul	500 cu. yds	1.00	500.00	1.00	500.00	1.00	500.00	2.00	1,000.00
14. Overhaul for Grav. Surf.	100 cu. yd. mi.	.50	50.00	.50	50.00	.24	24.00	.80	80.00
15. 12" Culvert Pipe—In Place	150 Lin. ft.	2.40	360.00	1.50	250.00	2.00	300.00	2.50	375.00
16. 18" Culvert Pipe—In Place	50 lin. ft.	3.40	170.00	2.00	100.00	2.00	125.00	3.00	150.00
17. 24" Culvert Pipe—In Place	50 lin. ft.	5.70	285.00	2.50	125.00	3.25	162.50	3.80	190.00
18. Furn. & Plc. Tunnel Timber	3,750.000 F.B.M.	45.00	168,750.00	45.00	168,750.00	45.00	168,750.00	45.00	168,750.00
19. Remove Part of Tunn. Timb.	30,000 F.B.M.	10.00	300 00	10.00	300.00	10.00	300.00	10.00	300.00
20. Rip-Rap in Place	80 cu. yds.	2.50	200.00	4.00	320.00	4.00	320.00	4.00	320.00
21. Conc. Tunnel Lining	12,800 lin. ft.	26.00	332,800.00	48.00	614,400.00	40.00	512,000.00	41.60	532,480.00
22. Class "B" Conc. in Place	550 cu. yds.	15.00	8,250.00	12.00	6 600.00	9.00	4,950.00	8.30	4,565.00
23. Class "C" Conc. in Place	700 cu. yds.	15.00	10.500.00	14.00	9,800.00	10.00	7,000.00	9.50	6,650.00
24. Class "D" Conc. in Place	0 cu. yds.	12.00	240.00	16.00	320.00	16.00	320.00	27.78	554.00
25. Class "E" Conc. in Place	1,000 cu. yds.	30.00	30.000.00	20.00	20,000.00	20.00	20,000.00	12.65	12,650.00
26. Beaded Copper Water Stops	18,150 lbs.	.50	9,075 00	1.00	18,150.00	.50	9,075.00	.81	14,701.50
27. Plain Copper Water Stops	34,400 lbs.	.01	344.00	.40	13,760.00	.48	16,512.00	.66	22,704.00
28. Furn. & Inst. Grout Pipes	3,000 lin. ft.	.60	1,800.00	1.00	3,000.00	1.25	3,750.00	.60	1,800.00
29. Drilling Grout Holes	200 lin. ft.	1.50	300.00	1.00	200.00	1.00	200.00	1.70	340.00
30. Pressure Grouting	30,000 cu. ft.	.50	15,000.00	1.25	37 500.00	1.00	30,000.00	.77	23,100.00
31. Sand for Grouting	15,000 cu. ft.	.40	6,000.00	.10	1 500.00	.20	3,000.00	.31	4,650.00
32. Rein. Steel—Tunnel Lining	5,000,000 lbs.	.045	225,000.00	.04	200,000.00	.0428	214,000.00	.045	225,000.00
33. Rein. Steel in Structures	100,000 lbs.	.07	7,000.00	.05	5,000.00	.05	5,000.00	.046	4,600.00
34. Pipe Hand Rail in Place	75 lin. ft.	3.00	225.00	1.00	75.00	4.00	300.00	3.20	240.00
35. Appurt. for Hoist House	Lump sum		750.00		500.00		500.00		570.00
36. Head Gate & Appurt.—Comp.	Lump sum		16,000.00		16 500.00		17,000.00		21,300.00
37. 30" By-Pass Valve—Comp. Inst.	Lump sum		1,250.00		1,300.00		1,800.00		1,910.00
38. Tr. Rack, Tr. Rake & Hoist—Inst.	Lump sum		8,700.00		7,000.00		11,000.00		15,400.00
39. Check. Pl. Etc. of Intake Struc.	Lump sum		700.00		400.00		500.00		630.00
40. 17' Steel Tunnel Liner	116,000 lbs.	.12	13,920.00	.08	9,280.00	.10	11,600.00	.10	11,600.00
41. 17' St. Liner—Surge Tank Found.	85,000 lbs.	.12	10,200.00	.08	6,800.00	.105	8,925.00	.096	8,160.00
42. Inst. Lamp Posts	6 only	25.00	150.00	15.00	90.00	25.00	150.00	32.00	192.00
43. 12" C. I. Pipe in Place	315 lin. ft	9.60	3,024.00	4.00	1,260.00	5.00	1,575.00	6.60	2,079.00
Totals			$1,737.933.00		$1,919 759.00		$2,216.998.50		$2,337,909.50
1. Additional or reduced tunnel excavation		10.00		4.00		7.00		7.80	
2. Additional or reduced conc. in tunnel lining		8.50		11.00		12.50		11.00	
3. Add. price for bronze cables on hd. gate hoist	Lump sum				500.00		300.00		3,000.00
4. Add. price for bronze cables on tr. rake hoist	Lump sum		150.00		80.00		1,000.00		2,000.00